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Sixteen-Inch Engine Lathe.

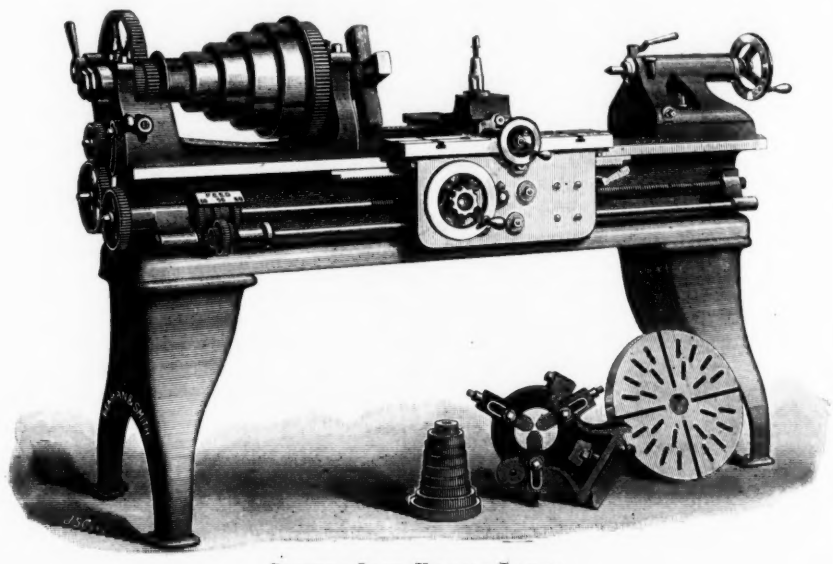
The accompanying illustration is of a 16″ engine lathe recently brought out by Beaman & Smith, of Providence, R. I.

In its construction, no attempt has been made to make any radical departure from the usually accepted standard regarding an engine lathe, but it has been the aim to construct it in a substantial manner, make it sufficiently accurate for the best class of work, and secure convenience of operation.

A novel feature is, however, introduced in the method of driving the feed rod, the gears for which are shown in a separate engraving, Fig. 2 (page 2). On the lead screw inside its main bearing are fixed three gears of different sizes, and on the feed rod is a sleeve upon which are three gears, any one of which may be brought into action with its mate on the lead screw by sliding the sleeve to the proper position, which may be done while the lathe is in motion. By this means three rates of feed are obtained, which can be changed from one to the other with the greatest facility, and at the same time the feeds are positive. The proportions of the gears are such that the different feeds obtained by them are in the proportion of 1, 2, and 3, so that with the 48 gear on the stud, and 72 on the screw, the feeds will be 30, 60 and 90 per inch. It is thus seen that, besides the other advantages named, a great range of feed is readily obtainable. The automatic cross-feed is of course also variable by the same means, and both feeds may be thrown in at the same time without danger of injury.

The head has a five-stepped pulley for a $2\frac{1}{2}$″ belt, the largest diameter being 12″, and the back gears proportioned 11 to 1. The spindle runs in hard bronze boxes, and has a hole through it $1\frac{5}{16}$″ diameter.

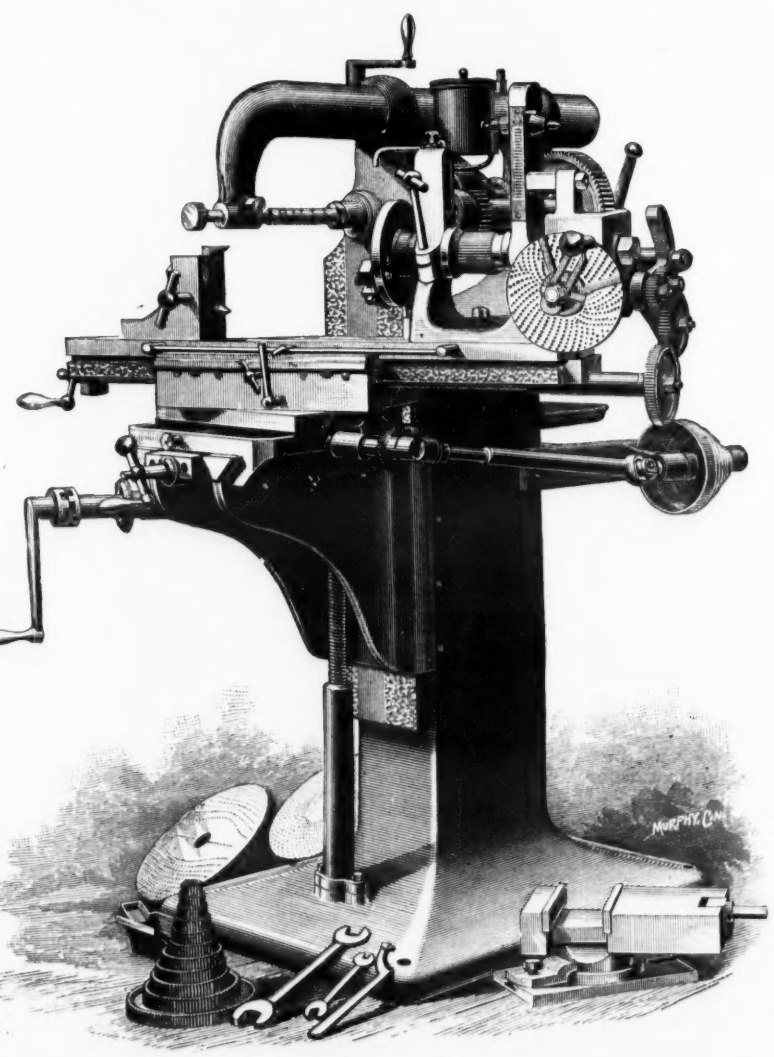
The front bearing is $2\frac{5}{8}$″ diameter, 5″ long; the back bearing $1\frac{3}{16}$″x3″. The foot-stock spindle is $2\frac{1}{4}$″ diameter, 13″ long. The carriage has a bearing of 24″ on the ways, and, as shown in the illustration, is a plain gibbed carriage, though any style desired can be furnished. The lathe swings over the rest 9″, and, with 6-foot bed, turns 28″, and weighs 2,150 pounds.



SIXTEEN-INCH ENGINE LATHE.

Universal Milling Machine.

Accompanying this is an illustration showing a milling machine, which, in its present improved form, is built by the Cincinnati Milling Machine Co., its prototype having been built by the Cincinnati Screw and Tap Co. The platen of this machine has a quick return of 3 to 1, so arranged that it may be run back its full length continuously. It has practically square gibs, which are adjustable and can be firmly locked. It swings 45° each way, and is fed automatically at any angle. The shaft for elevating or lowering the knee is mounted at an angle of about 45°, and a clutch crank used on this shaft, which may be disengaged, yet remains on the shaft ready for immediate use. This arrangement admits a permanent handle, for the screw operating cross motion in line of spindle avoids the necessity of changing handles from one shaft to another, secures rapid and convenient adjustment, and admits of large plain dials. The attachment for cutting spirals is a simple arrangement, fastened by means of a nut to the center head. For doing plain work rapidly, this attachment is taken off and plain centers used with index plates. These index centers embody several improved features. The head-stock is provided with a clamping device, which firmly locks the spindle during cutting operations thus relieving the index pin and dial plate of all strain. A ¼″ hole is drilled through the index spindle for driving out centers. This also admits long shafts, which may be held in a universal chuck. The tail-stock center bar is elevated or lowered by means of a rack and pinion, and is reversible, having on one end a small center with top milled off, and on the other a full round center. Various other attachments are made, including a universal dividing head—designed to embody great range and stiffness—a rack cutting attachment, and a swivel vise.



UNIVERSAL MILLING MACHINE.

The overhanging arm for supporting outer end of mill arbor is four inches in diameter, and can be quickly brought into position, or swung out of the way, as may be required. The spindle on front end has a taper bearing running in a solid bronze box. A very close adjustment is secured for spindle by means of a new lock nut. This same nut is used on all screws where adjustment is necessary. All feed-screws have graduated dials. The machine is fully back-geared, has six spindle speeds, and six changes of feed. All necessary wrenches, gears, etc., accompany each machine.

Bent Crank Shafts.

BY W. H. BOOTH.

To the non-technical observer, and even to many engineers who are not specially familiar with smith work, the bending of a cranked shaft from a round bar will appear a very simple operation, involving the heating of the bar at a portion of its length, and then straining round a corner, as in Fig. 1 (page 2), where a bar is shown as being bent over a block, to which it is secured by a strap and wedge. Ask a smith to point out the faults of this method, and he will point first to the corner *o*, and explain that in bending round this corner to a square bend the material must inevitably be extended, and in place of showing finally a circular cross-section the ultimate section would be somewhat as in Fig. 2, wanting considerably of the full circular form, which has been destroyed by the draft of bending. He will next point out how ungainly such a method of bending may sometimes be in a confined shop.

There is a good deal of skill required in bending cranks, especially double and treble throws, and the method of procedure for moderate sizes is as follows:

A straight bar is chosen, of a length which will complete a shaft. This length is, of course, the sum of the finished length of the shaft, and the lengths of the arms, and certain allowances for draft and end finishing. The bar is then marked at certain portions of its length, and these parts being heated up, the bar is jumped until the heated portions become considerably thickened, the extra thickness being taken out of length, the jumped bar being so much shorter than it was originally. Then to form each bend the bar is secured upon a fixed block, as in Fig. 3.

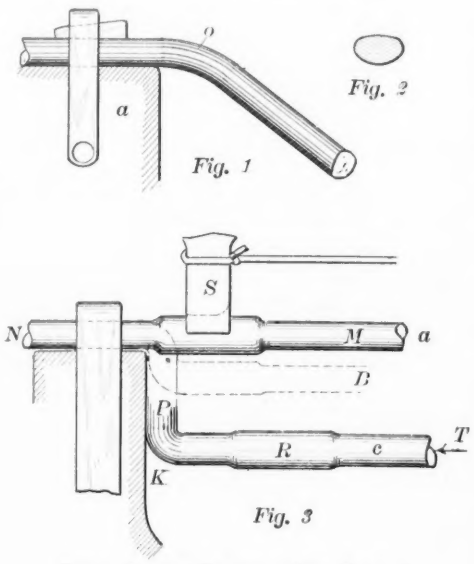
A hollow set is placed on the bar at *S*, and a falling weight, working by a rope over a pulley in the ceiling above, drives down the set, and with it the bar, into the successive positions *B* . . . . . *C*. Now the end *M* of the bar in this operation keeps almost in a direction parallel to the end *N*. It is kept exactly so by striking endwise at *T* with another swing tup, which is used with a force sufficient to maintain a proper roundness at the corner *K*.

When down to the position *C*, the whole of the swell under the set *S* will have disappeared if properly jumped to size, and will now form the arm *P* of the crank. The same operation has to be repeated for the other arm of the crank, which is formed from the next jump *R*, and so on until the shaft is completed. Now it is clear that after forming a crank there would be danger of fracture or distortion if any further end jumping were to be performed. Hence the

necessity of completing all jumped swells before bending; and right here comes in the skill and judgment of the smith who sets out the swells on the plain bar, any miscalculation in the position of which might produce a waster. Further, if excessive length of swell is made, the finished job is a piece of turning—not a forge finish, as every part should be excepting bearings, and these should require but little removal of material, or the continuity of fiber, so precious in a bent crank—indeed, its only excuse for mechanical existence—is destroyed. Properly carried out, the arms of cranks thus swaged down are perfect as specimens of smith work, and when skillfully jumped have just such an excess of section above that of the plain bar as to present a good appearance and preserve full corners. Though apparently knocked down by the swage, the real principle of the operation is that of bending the plain bar simultaneously at two angles by very small steps in rapid succession.

It is easy to see that the same principle of bending may be carried out by hydraulic pressure on the same lines.

In any case, good work is the outcome of judicious jumping, heating and bending, and cranked shafts of large size—8 inches diameter—are now made from plain bars by the bending process, which have far less liability to fracture than have cut-out webs.



BENT CRANK SHAFT.—SEE PAGE 1.

Master Mechanics' Association.

EXTRACTS FROM REPORTS OF COMMITTEES.

At the meeting of the American Railway Master Mechanics' Association, held at Niagara Falls, June 18, the various committees appointed at the previous meeting rendered their reports, from which we make the following extracts:

The committee on driver-brakes [Chas. Blackwell, H. D. Gordon and W. H. Thomas] find that the use of this device has, within the past two or three years, increased in a very marked degree, evidently accompanying the recent increment in weight and speed of both passenger and freight trains.

The still more general use of the driver-brake appears probable, and will doubtless result in the safer operating of our railroads.

The Westinghouse Company report that up to the present time they have furnished about 7,500 sets of driver-brakes of their type, and that the American Brake Company has supplied about 3,800 sets of their style of brake. The Eames Vacuum Brake Company state that their driver-brake is in use on 364 different railways, but do not give the number of sets. * * * *

Some master mechanics consider it better, in view of possible failure of the power operating the train brake, and which, on account of its most general adoption, may be considered compressed air, to use either steam or vacuum for applying the driver-brake. This should be arranged without an additional handle for engineer; for, as your committee are of opinion that the driver-brake should, as a rule, be used in conjunction with train-brake, on both passenger and freight engines, the additional handle would cause confusion. * * * *

When driver-brakes are used for making all stops, each wheel should be braked, or unequal wear of tires, and consequent difference in diameter, will result, especially where the ordinary narrow shoe is employed; hence your committee advise the application of brakes to each driving wheel.

Experiments are now being extensively tried in order to determine the best material, or combination of materials, and also the best form for driver-brake shoes.

Your committee unhesitatingly recommend the principle of the Ross shoe, but are not prepared to state conclusively, until more exhaustive trials have been made, if the cast-steel, the Meehan, the Lappin or the Congdon make of the Ross shoe will, all things considered, give the best results. The steel shoe, while possessing great endurance, is charged with excessive wear of the tires; but this feature may be overcome by modification in the composition and treatment of the metal. * * * *

Your committee feel compelled to point out the unfortunate existence of an excessive number of different patterns of brake-heads and shoes now in general use. Where clearance between wheels is limited, special forms of heads and shoes are necessary, but these special patterns, as well as those used where plenty of room exists, should be reduced to a minimum, and care taken to make those of a kind thoroughly interchangeable, which, it is to be regretted, is not always done.

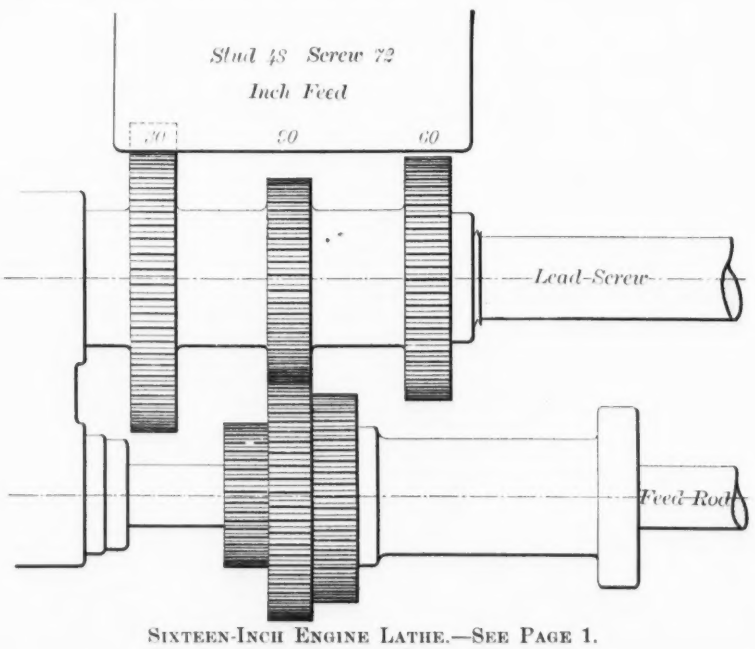
As regards the most desirable ratio between brake-shoe pressure and weight on rail, your committee recommend for the Ross pattern of shoe and clasp-brake, from 30 to 35 per cent.

The pressure per square inch sustained by brake-shoes varies in different designs that have come to the notice of your committee from 50 to nearly 200 pounds. Until more is known on this point, they refrain from recommending limits within which best results may be expected.

The Le Chatelier, or water-brake, is practically a driver-brake, and, as a device for holding engines on heavy grades, appears to be too little known.

Mr. N. W. Sample, Superintendent M. P. of the D. & R. G. R. R., reports as regards this brake:

"We never pretended to use it for the purpose of retarding trains, as we have had all our cars and engine tenders equipped with air brakes since 1877. For the purpose of holding light engines on heavy grades, where the tank brake is not sufficient, there is certainly nothing so good as Le Chatelier's device. We use it on our locomotives daily on grades from 100 to 408 feet per mile. We have no driver-brake shoes. We discarded all brakes that apply directly to the face of the driving wheels, eight years ago. In my opinion, the very best driving brake is Le Chatelier's device.



SIXTEEN-INCH ENGINE LATHE.—SEE PAGE 1.

The committee on Driving and Engine Truck Boxes, consisting of Wm. Buchanan, Jno. W. Cloud and J. M. Boon, reported that for driving boxes, when made of strong, close iron of good design, cast-iron will give good results. In many cases where cast-iron is used, the box is not properly proportioned, from a desire to use the same size pedestal and box as used for lighter class of engines, or using a larger driving shaft, the box is reduced and made too light, and breakage is the natural result. The weight of locomotives is steadily increasing, yet it is not unusual to find a driving box on an engine weighing 50 tons but little heavier than one for a twenty-five or twenty-eight ton engine. This is one cause of driving boxes breaking. Another is from the desire to have as wide a fire-box as possible; the frames are thrown out, space reduced between frames and hub of driving wheels, making light flange on driving boxes; broken flange the result. When the fire-box is set on top of frames, another trouble develops, that is, the danger from hot boxes caused by the cinders and ashes falling from fire-box into driving boxes and bearings, causing them to heat.

Practice has shown cast-steel to be an inferior metal for driving boxes; it being a stronger metal than cast-iron, weight can be reduced in castings, which is about the only merit it possesses. The most serious objection to it is that it wears badly when in contact with cast-iron, as it must be with inside hub of driving-wheel, when not only the box wears rapidly, but also the hub.

Your committee has knowledge of 30 engines with cast steel driving boxes, on which the hub and boxes had worn in two years so much lateral motion, that ½-inch liners had to be fastened to the boxes. These liners were made of cast-iron and brass; the cast-iron was found to wear well and gave the best results. At the same time these boxes and hubs were wearing, 70 engines built from the same plans with cast-iron boxes gave no trouble, and after five years' service had not worn lateral motion enough to need taking up.

Another objection to cast-steel is that the metal expands at a low temperature. A bearing becomes hot from some cause, the heat will expand the box more than the brass, which will (if circular shell pressed into box) become loose and necessitate tightening up. Bronze and brass, being alloys of copper, will be treated as one metal. There are but few driving-boxes made of these metals in this country. In Europe, it is the rule to use them—they are the best metal for the purpose. Your committee are of the opinion that the coming driving-boxes will be made of these metals, solid bored out to fit the shaft. The thought of the cost of the bronze or brass over cast-iron may at first be startling, but it is likely to prove economical, when it is taken into consideration that the patterns can be made lighter than for cast-iron, the slotting out for bearing and fitting of same saved; the planing, boring and fitting will cost no more than cast-iron, and the box will wear until worn through at the top, or so light as to be unsafe, the loss from wear of bearing will be no greater, and there will be a saving of tightening up old and fitting new bearings.

When the box is finally worn out, the credit for scrap will make a considerable reduction on cost of new box. The objection might be urged that in case of a hot journal the box might be ruined; extreme cases like this rarely occur.

Where bearings had been cut or roughened, they could be re-bored same as is now done with separate bearings. The form of bearing now generally used is the half round shell; the tendency of these bearings is to become loose, the shape of the bearing and the strain it is subjected to contribute to this end. The weight on the crown of the brass, and wear on inside, naturally causes the lower ends to close in away from the box and binding on the journal, causing heating and pounding of bearing in box.

The weak point of these half-round bearings is the lower edges, which take the pressure in forcing bearing into box; these edges seldom have over three-quarters inch bearing, and it is not unusual to see them not more than ⅛ inch.

As the shells are forced to place in the box with from 20 to 30 tons pressure, it will be readily seen that with this inadequate bearing on the edges it is impossible to keep shells tight; a width of one and one-quarter inches would scarcely be sufficient. * * * *

A better shape in every way for journal bearing in driving box, is what is known as the hexagon; this form can be fitted into the box without pressure; having no strain on the box, it can be made lighter than the shell, and yet have more metal at the bearing points; by casting lugs on the top angles seven-eighths or one inch wide on bearing and corresponding recesses in the box, it is held to place with no further trouble. The cost of properly fitting this bearing in is more than the shell bearing, and final result is more satisfactory.

If the half-round bearing is to remain as a fitting of locomotive driving boxes, a radical departure will have to be made in increasing width of pedestal openings to admit of wider boxes and heavier bearings which have got out of proportion to the heavy engines, larger driving shafts, higher boiler pressure, and greater speed of modern practice. * * * *

The committee on Tires; Advantage or Otherwise of using Thick Tires, consisting of Henry Schlacks, C. E. Smart and J. W. Stokes, sent circulars of inquiry to members, asking, amongst others, the following questions:

Can you give any figures showing the amount of wear to tires occasioned in handling engines by different engineers?

This question was intended to bring out, if possible, something more definite in regard to the influence the engineer exerts on the wear of tires.

At the last convention it seemed to have been almost a unanimous feeling that the engineer was greatly responsible for the condition of his tires, and of those who expressed their ideas in figures, the lifetime of a tire might be increased from 25 to 100 per cent. by careful handling. The only figures given in answer to this question are by the Illinois Central Railroad. The comparison made gives the mileage of three engines in suburban service. These engines are of the "Forney" pattern, built at the same time and to the same drawings. They are equipped with driver-brakes with the plain shoes, and have the same brand of tires 3½ inches thick. The service is such that each engineer makes the same number of trips over the same part of the road each day with the same number of cars, stopping on an average of every two minutes. Every precaution was taken throughout to make all the circumstances and conditions connected with the running of these engines alike.

The engineers, all of whom are good, conscientious men, were notified that a comparative record of their tires would be kept, and each man was to do his utmost to make a large mileage. The following is the result to date: The first engine made 103,618 miles to $\frac{14}{16}$ inch wear of tire, an average per unit wear of 7,400 miles. The second made 111,345 miles to $\frac{24}{16}$ inch wear, an average per unit wear of 4,635 miles. The third made 112,455 miles to $\frac{24.5}{16}$ wear, an average per unit wear of 4,243 miles. The average of the remaining 14 engines of the same type and service was less than the third case above mentioned.

What is the cost at your shop of disconnecting an engine, taking out wheels, turning tires and replacing wheels ready for service?

This amount varies from $14.50 to $37. As a rule the condition of tires causes an engine to be taken into shop when otherwise she would have made in many cases from 20 per cent. to 50 per cent. more mileage before requiring repairs to machinery, but being in for tire turning, and different parts of the machinery taken down, it is generally considered advisable to do a limited amount of work to the machinery, so that it will not be necessary to hold the engine for this work before she comes in again for tire turning, and it is safe to say that quite a large proportion of the expense of repairs to machinery is directly caused by tire wear.

In conclusion, state the reason why you think a thick tire better than a thin one, or vice versa.

Though the records of wear of thick and thin tires received could scarcely be taken as a general average, it is all the committee have to consider. This wear showed about 20 per cent. more mileage in favor of the 3-inch tire, whereas, in comparing the cost, we find the 4-inch tire is 10.9 per cent. cheaper than a 3-inch tire. Now, with all the other influences incidental to tire wear, such as use of sand, slipping drivers, use of driver-brake during the same period, the fact that one set of tires will do much better than another set of the same brand and thickness under the same engine, handled by the same engineer, the diversity of opinions of the members of this association, the committee find it very difficult to say, with any degree of certainty, which of the two is the better.

Undoubtedly the best and most economical tire for railroad purposes is the one making the greatest mileage per unit of wear. A greater service from the engine is thus obtained on account of fewer interruptions to business, with a corresponding decrease in repairs to engine, but to determine to a certainty the original thickness or the physical condition of the metal to perform this mileage is a problem requiring much more definite data.

The Illinois Central has prepared a statement showing the performance of 252 sets of tires of the same brand, varying from 2¼ to 3½ inches in thickness, in all kinds of service. The total mileage was 45,698,728 miles, and the total wear 3,988-sixteenths, an average of 11,459 miles per unit of wear. Another statement shows the performance of 33 sets of tires of another brand varying from 2¼ to 3½ inches in thickness, all but two sets having been in passenger and freight service. The total mileage for these was 5,087,042 miles, and the total wear 621.5-sixteenths, an average of 8,185 miles per unit wear. Although the original cost of the former was 7¾ cents per pound, and the latter 5¼ cents per pound, a difference of 32.2 per cent., the cost per 1,000 miles run of the former was 12.78 cents and the latter 12.19 cents, a difference of only .59 of one cent, and taking into account that the cheaper tire required to be turned five times, whereas the former only required four turnings during the same period, aside from losing the service of the engine during the fifth turning, it will be seen that the former is considerably the cheaper tire, although at a great difference in original cost.

The committee on Water Space Surrounding Fire-box and Flues of Locomotives sent out a circular of inquiry, some of the replies to which are as follows:

To the first question: "Do you think the water space usually allowed between inner and outer sheets of a locomotive fire-box sufficiently large to permit a free circulation of water in contact with the heated sheets, under circumstances of a high temperature in fire-box?"

Eleven master mechanics say in substance: I do not consider the water space usually allowed sufficiently large for free circulation, and while I have made no special experiment or tabulated statement to demonstrate the fact, I have arrived at this conclusion from a close observation of comparative results. Three say: I have not observed any facts to lead me to believe that the water spaces surrounding the fire-box of the ordinary locomotive was insufficient.

To the question: "Have you made any experiments to demonstrate your conclusions? If so, please state particulars."

Nine say they have made no experiments; four say they have increased the water space surrounding the fire-boxes from 2½ and 3 inches, to 4 inches, with results of greater durability of fire-box sheets, and decidedly freer steaming engines.

To the query: "Can you suggest a means whereby a better circulation of water in the space surrounding the fire-box would be assured?"

Six master mechanics answer "No"; eight say, increase the water space to four inches by all means, even should it be found necessary to decrease the grade area to attain this point.

The fourth question: "If you suggest a change in shape of the fire-box sheets to accomplish the purpose, will such change interfere with the space in the fire-box allotted for combustion?"

Five pass this unanswered; two advise placing fire box on top of frames to get the desired water space; one answers: "Make slab frames and get a wider fire-box," and six assert that the small reduction in fire-box necessary to obtain the desired increase of water space would not perceptibly decrease the efficiency of the combustion chamber. * * * *

To the question: "Do you consider the clearance space usually allowed between the boiler tubes of a locomotive sufficiently large to permit the highest evaporative power at that point under condition of the maximum heat in fire-box, and assuming the boiler tubes to be two inches outside diameter, what clearance space do you allow between them?" Eight master mechanics answer: Do not think space as usually allowed large enough, and suggest a clearance space of ¾ inch; two say the same, except they suggest a clearance space of ⅞ to 1 inch; two say ⅝ inch clearance is ample.

To the question: "Do you prefer placing boiler tubes in flue sheets in line vertically, or situate them zigzag fashion? Please state your reasons for the preference." Three say zigzag fashion, because it admits of a larger number of flues, thereby increasing the heating surfaces; all others are understood to say the vertical passages between tubes should be straight, not zigzag as is the usual custom.

To the question: "Do you favor the use of ordinary crown bars, placed in the usual manner, for staying the roof sheet of fire-box? If not, please state objections." Three answer, "Yes," but qualify this assertion by saying that, while it has bad features, it is the safest known method; nine give a decided negative, adding in substance that this manner of staying causes a rapid accumulation of scale and mud, greatly impedes the circulation of water, thus reducing the efficiency of that important heating surface, as well as tending to a rapid destruction of the crown sheet.

In answer to the question: "Have you adopted a system of radial stays for crown sheet, or any method of staying said sheet, differing from the old style crown bar? If so, please send the committee sketch showing the manner in which it is done." Three say they have adopted a system of radial stays for all new engines; eight say they have not yet adopted this system, but are thinking of doing so.

To the last question: "Do you favor the use of flat or circular crown sheets for locomotive fire-boxes, and which method do you regard the most efficient for transmitting heat?" Three prefer flat crown sheets; one uses the Belpaire type of boilers for all new engines, and with it a flat crown sheet. The flat sheet, he states, has many advantages, one being the full thread it permits in the shell for the purpose of direct stays; it also admits of a larger volume of water at that point than a curved sheet. All others say they prefer a sheet slightly concave toward the fire, holding as a reason that this shape adds to its resisting power, and from its increased surface in contact with the water is more efficient in transmitting heat. * * * *

Summarizing the answers as impartially as may be, your committee find there is almost an unanimous sentiment in favor of enlarging the water space between the inner and outer sheets of a locomotive fire-box. This feeling also prevails regarding the clearance space between the boiler tubes. It is generally admitted that where the feed water is largely, or even moderately charged with foreign matter, the water space on the back and sides of the fire box should not be less than 4½ inches, with a distance of not less than 5 inches between the front sheets of box, while a few advocate a water space surrounding fire-box of 5 inches.

The ordinary American type of locomotive boiler with deep fire-box has usually been given but three inches water space between the side and back sheets. When replacing fire-boxes, many have increased this to 4 and 4½ inches, and have obtained therefrom the most satisfactory results, both as to durability of fire sheets and augmented evaporation. * * * *

The information received by your committee, particularly from locations where the feed water contains scale-producing elements, leads them to believe that the general feeling is there should be a clearance space of ¾ inch between 2-inch tubes in locomotive boilers, and that the spaces between should be in straight line vertically, the latter condition offering not only less hindrance to the circulation, but be a great aid in precipitating the deposited matter. * * * *

Your committee regret not having sufficient information at hand from which to compile a report based on comparative results, and the committee not having had time or opportunity to make the necessary tests, feel that any further recount of the subject must be largely suggestive.

The serviceable period of a locomotive is dependent largely on the duration of its boiler. The limit of power is determined by the boiler; the generating power, the safety and duration of a boiler mainly depend on the facilities offered the water for reaching and remaining in contact with the heated surface. The efficiency of the heating surface is measured by the amount and frequency of the water in contact with it, therefore any effort tending to promote the freedom of, or hasten the action of the water towards the heating surface, or in any way encouraging its presence at the heated sheets, is one towards increasing the power, the efficiency and the duration of a locomotive.

The evaporation per pound of coal used, in a large majority of locomotive boilers, is far less than should reasonably be expected. This is undoubtedly owing, in part, to an insufficient supply of water in proximity to the fire sheets, caused by the narrow water spaces surrounding the fire-boxes, together with the flues being set so closely together that the circulation of water among them is greatly impeded, thus reducing the efficiency of the heating surface. These conditions are further aggravated by the scale deposit on the transmitting surface, and this, with the usual cumbrous manner of staying the crown sheet, hindering in consequence the circulation, thus impairing the efficiency of this sheet as a heat transmitter.

The results of improper circulation of water in a boiler are not confined to the loss of a reduced evaporation for a given amount of fuel used; to this is due the rapid deterioration of the fire-box plates caused by overheating, the pernicious effects of which are scarcely realized. When plates are overheated, the unequal expansion of the inner and outer sheets strain them to such an extent that frequent renewal of stay bolts becomes necessary; there is also danger that overheating may cause an expansion of the metal to a point in excess of its elastic limit, in which case a permanent set must occur, and the metal is in precisely the same condition as though the limit of elasticity had been exceeded by overstrain. * * * *

The evaporative efficiency of a boiler depends, no doubt, to some extent, on the nature and thickness of material forming the heating surface. Carefully conducted experiments, some years since, however, and the results later of actual practice, show that, after the first few days of work with ordinary impure feed water, there is no perceptible difference in the evaporative power of copper, brass and iron tubes, although their relative conducting power, when clean, are, respectively, 74, 24, 12, and that, so far as the economical use of fuel is concerned, there is no gain in using the highest priced metal; it is remembered that the same result was found when using slightly different thicknesses. The difference between the steaming power of new boilers with furnace plates ½ and $\frac{5}{16}$ inch thick was found to be materially in favor of the thin sheets; but it is asserted that this difference disappeared as the plates became coated with incrustation. It is a fact well known that furnace plates having a thickness of ½ and $\frac{7}{16}$-inch are more liable to fracture than $\frac{5}{16}$-inch plate, and this argument is at times used to prove the inferior evaporating power of thick plates; this, however, does not necessarily follow; the injury to thick plates is mostly caused by unequal expansion, this evil being directly proportional to its thickness. Considering the speed of the heated currents in a locomotive fire-box, and the short time allowed for transmission, a homogeneous plate of absolutely uniform thickness, and about $\frac{5}{16}$ inch thick, practically appears to be best adapted to perform all duties required of the sides and back plates of a furnace. * * * *

The committee on Magnetic Influence of Iron and Steel in Locomotives on the Watches of Engine Runners, consisting of T. W. Gentry, James Meehan and Harvey Middleton, had evidently made a very thorough and painstaking investigation of the subject, the following being the more important points of the conclusions at which they had arrived:

We find that the magnetic influence of iron and steel in locomotives, while it may affect the watches of runners to a very slight degree, as a rule it does not amount to a serious disturbing element; and that if a watch is not exposed to any other more powerful electrical agent than the ordinary locomotive engine, no difficulty would be experienced in keeping accurate time-pieces.

We are satisfied, however, from our inquiries and from the answers to the questions propounded by the committee, that the watches of locomotive runners are subjected to more rough usage than those carried by men in any other line of business; and that we frequently attribute to magnetic influence disturbances which are really occasioned by a sudden jar or jolt, or some one of the many little daily occurrences to which the watches of engine runners are subjected. * * * * *

Your committee found that there is much more danger in magnetizing the watches of locomotive runners from contact with, or exposure to, the influence of powerful dynamos, magnets or currents such as may be met with in any large town or city at the present day—in the shape of electric light apparatus, electric motors and other electrical plants; and as many of our locomotive runners are of an inquiring disposition, and likely to be interested in machinery of all kinds, it is more necessary to try and protect watches from this cause than from any real danger in connection with the iron and steel in locomotives. * * * * *

Your committee in going over the large number of statements from locomotive runners, are convinced that much depends upon the handling of the watch and the care given it by the man in whose charge it is; and that an inferior time-piece in the hands of a careful man is sometimes more reliable than the finest watch in the hands of a runner who has no system in his method of winding, adjusting, etc. We mention this fact as having some bearing on the various causes of disturbances which the magnetic shield could not be expected to remedy.

Self-Instruction for Young Mechanics.

By FRANK RICHARDS.

VIII.

We may now venture to look a little at the standard and traditional diagram that has always been used to show the principles of isometric projection. It is very convenient for the purpose, and I have not meant to treat it with any disrespect. Here is a plane projection of a cube, Fig. 1. Of course all its sides are equal, and all its angles are right angles. Here is the isometric projection of a cube, drawn to the same scale, Fig. 2. The sides are still equal to those in the plane projection, and still equal to each other; but the angles are changed. Two opposite angles of each face of the cube have become obtuse angles, and the two alternate opposite angles have become acute angles. The square has become a rhombus.

Now no mechanic has any respect for a rhombus. He always thinks of it as a square that has been spoiled in making. It has tipped over, Fig. 3, before its joints have set, you know. But the same mechanic has great admiration for the diamond; so here we present him with a couple of them, Figs. 4 and 5. You will have hard work to persuade him that they are the same old rhombus in disguise. It may be that the disguise was the other way, and that what we habitually think of as the diamond is the real thing. We certainly know more of its properties under that name. We regard it as one of the most symmetrical of figures. It is symmetrical in relation to both of its axes or center lines. When a square becomes a rhombus, as it does when we make an isometric projection of a square surface, the thing that occurs in connection with the change of the angles is a change in the length of the diagonals, or the lines connecting the opposite corners of the square. One becomes longer and the other becomes shorter. But, however much the square may be tipped over, and however much the angles may be changed, the two diagonals always remain perpendicular to each other. We encounter this principle frequently in machinery, in "lazy tongs" and movements of that character. This was why the corners of our brick, tipped over at 45°, appeared as right angles. The sides and ends of the brick had then come into the position of the diagonals of a square.

The rhombus that occurs in true isometric projection always has the same angles, so we need not chase our diamond to any extremes. In isometric drawing the proportional length of either diagonal of the rhombus to the side of it is always the same, and the proportional measure of any figure, when measured in a direction parallel to the diagonal, will be changed in the same ratio. A circle lying in the plane of either square face will be elongated in the line of the longer diagonal, and in the same proportion as the diagonal is itself elongated, and it will be shortened in the line of the shorter diagonal. The circle becomes an ellipse, and it is an ellipse of constant shape. If we can find the constant relative lengths of the two diagonals we can know the constant ratio of the two axes of the ellipse to each other, and the ratio of each to the actual diameter of the circle represented.

The diagonal *a b* of the square, Fig. 1, being the hypothenuse of a right-angled triangle, and the other two sides each being 1, the diagonal will be $\sqrt{2}$, or 1.414. In the isometric drawing of the square, the right isometric or base line *b c* being 30° from the horizontal, and *a b* being vertical, the angle *a b c* must be 60°. Now we know, because everybody knows, or ought to, that 60° is the angle of an equilateral triangle, and the triangle *a b c* must be such a triangle. Then *a c* must be the same length as the other sides of the triangle. Its length must be 1. But its original length in the square was 1.414, and its present length is a fraction of its original length represented by $\frac{1}{1.414}$, and the measure of everything on this line will be this fraction of its original length. To obtain the length of the long diagonal we have here another right-angled triangle *a d c*, that will readily give us half of it, or the same triangle would do it. The length of *d c* is 1, and *e c* is of course .5, then the length of *d e* is $\sqrt{1^2 - .5^2} = .866$. This being one-half the long diagonal, its whole length must be 1.732. Its present relative length, then, treated the same as we served the short one, will be $\frac{1.732}{1.414}$. If now we make both of these into decimals, by dividing the numerator of each by its denominator, we get .707 and 1.224 as the proportional (not actual) lengths of the diagonals, and the proportional lengths of the axes of the ellipse will be the same. These will also be the actual lengths of the axes where the original diameter was 1.

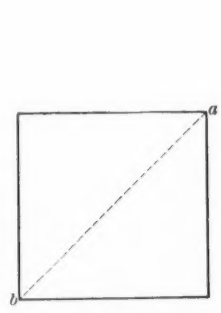


Fig. 1

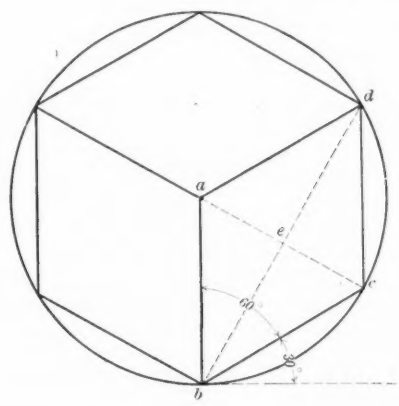


Fig. 2

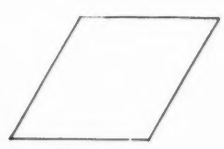


Fig. 3

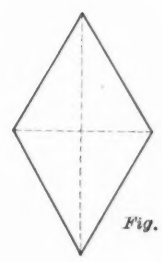


Fig. 4

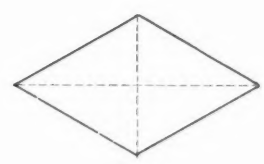


Fig. 5

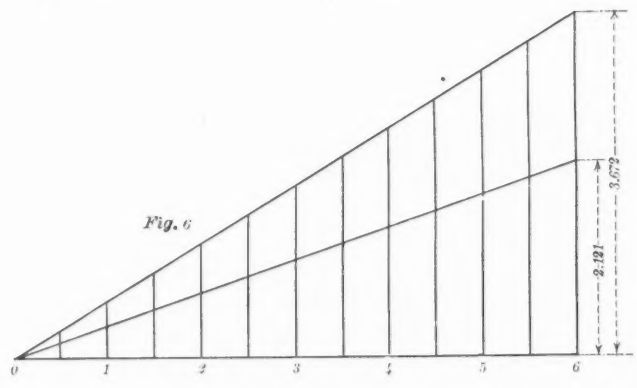


Fig. 6

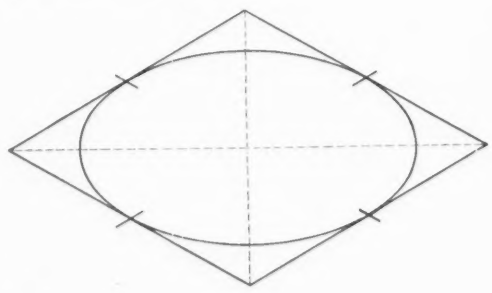


Fig. 7

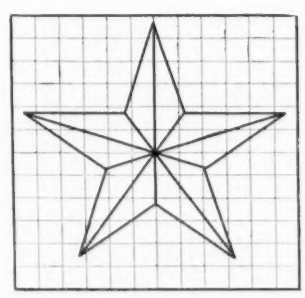


Fig. 8

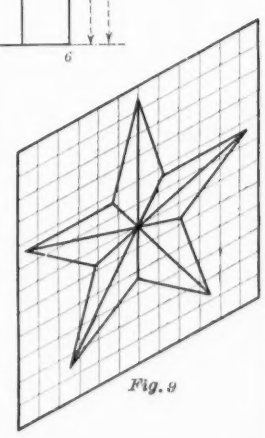


Fig. 9

Fig. 7 will touch the sides of the rhombus, as the circle touches the sides of the square, at the middle of each. Then if upon the two diagonals we measure off the extreme dimensions of the ellipse, as obtained from the scale, Fig. 6, or otherwise, we have eight points of the ellipse, and we can readily draw it in with sweeps.

If eight points are not thought to be enough to define the ellipse accurately, we can readily obtain as many as we choose. One method would be by the subdivision of the square into any number of smaller squares, and a corresponding subdivision of the rhombus. This method would apply to the reproduction of any figure, regular or irregular, in any isometric plane. By the way, Fig. 7, by turning it around, will correctly represent either face of the cube. The five-pointed star, Figs. 8 and 9, is not difficult, because only the five extreme points have to be located, the straight lines determining all the rest, and the system of squares was not necessary.

As I believe I said in the beginning, the difficulty of readily describing ellipses has had much to do with preventing the general use of isometric projection. If an ellipse could be described as readily as the circle can be drawn with compasses, we would use it more, and we would know more about it. I remember that I learned much of the properties of circles by scratching them on the ground with the tines of a pitchfork. An ellipsograph is too expensive a plaything for every boy to have; and the best of them, so far as I know, have the fatal defect of not making a good line in ink. They will describe an ellipse very nicely with a pencil, but, after all, the ellipse must be inked by hand, so that what we use to ultimately guide the pen in inking, we use for the whole process, and we put the ellipsograph carefully away upon the top shelf.

The ellipses made in sets that I find in catalogues of drafting instruments are not of the right proportions for isometric drawing. In those that I have examined—and I know of no others—the short diameter is .75 of the long diameter. The short diameter, the long diameter being 1, of the isometric ellipse, is: $\frac{.707}{1.224} = .579$. It would seem that it would pay makers of such things to get out sets of ellipses of these dimensions; but they know their own business. I suppose they would never happen to be of the right size for us.

The scale which I offer, Fig. 6, half size, should be of some use. This will readily show the semi-diameters of any ellipse within the range of it. The base line represents the actual diameter of the circle, and upon it may be raised vertical lines representing as many subdivisions of the inch as may be desired. Where these verticals are cut by the two oblique lines will be the corresponding semi-diameters of the ellipse.

Rand, McNally & Co., Chicago, have recently published a small book designed for the use of railway superintendents, train masters, train dispatchers, etc., called "Crull's Time and Speed Chart." The book is of a size convenient for the pocket, and is indexed by notched leaves, so that any page may be instantly turned to. Each page is devoted to a certain rate of speed for a train, the rates provided for being from 2 to 69 miles per hour. On each page the time consumed in running any distance from 1 to 150 miles is given in hours, minutes and seconds, and also the time for fractions of a mile, from one to nine-tenths. The tables are computed with special reference to trains being run without schedules, as specials, extras, etc., and afford a means of readily making out a special card with much less liability of mistake than by ordinary methods. We think it well calculated to save time and trouble, and increase the safety of railroad operating, and that it will meet with favor amongst railroad employes concerned in the running of trains.

The steel paddle steamer "Calais-Douvres," of 1,200 tons register, built by the Fairfield Shipbuilding and Engineering Company, for the London, Chatham & Dover Railway Company, attained, on her official speed trials, a maximum speed of 21¼ knots per hour and the average of several runs 20¾ knots, with the engines working at fifty revolutions per minute. The dimensions are: Length between perpendiculars, 325 feet; breadth, 36 feet; depth moulded to upper deck, 21 feet 6 inches. The engines are of the compound-diagonal, direct-acting type, with high-pressure cylinder 59 inches diameter, placed above a low-pressure cylinder 106 inches diameter; stroke, 6 feet; working pressure, 110 pounds per square inch. The paddle wheels have feathering floats.

We have received from Mr. P. H. Woodward, secretary of the Board of Trade of Hartford, Conn., a book published by the board, setting forth the advantages of Hartford as a manufacturing, business and commercial center. Brief sketches are given of the history of the city and its attractions, as well as of the important industries and institutions. It is a super-royal 8vo. of 220 pages, well illustrated and well bound, and contains much information that will be found of interest to manufacturers, business men and others.

By the courtesy of James H. Smart, LL. D., President of Purdue University, Lafayette, Ind., we have received the "Annual Register" for 1888–'89, together with an invitation to attend the fifteenth annual commencement. Prominence is given to the course in mechanical engineering, and the Register shows the school to be in a prosperous and healthy condition.

We are indebted to Prof. A. T. Woods for the catalogue of the University of Illinois for 1889–'90. We judge from it that the University is in a prosperous condition, and it is certainly well equipped for its work, especially in the matter of equipment for teaching the practice and science of mechanics.

The name of our correspondent who favored us with sketches and description of "A Handy Protractor," published in our issue of June 6, is Allan Strale, not Stratz, as we had it—simply another illustration of the necessity for writing names plainly.

Modern Locomotive Construction.

BY J. G. A. MEYER.

NINETY-FOURTH PAPER.

The following figures represent a throttle lever arrangement for engines, in which the throttle rod passes through the side of the dome. Similar letters in the different views indicate the same details.

Fig. 525 represents this throttle lever arrangement as seen from the back end of the boiler. Fig. 526 is a plan of the same; Fig. 527, a section of the steam gauge stand, stuffing box, gland and steam pipe connecting the steam gauge stand to the dome; Fig. 528 shows the throttle rod, and Fig. 529 the link used for connecting the throttle lever to the steam gauge stand.

The steam gauge stand marked *A* is often made of cast-iron; sometimes of brass, and is bolted to the top of the boiler by means of two studs passing through the holes *a a*. The throttle rod *G* works in the brass stuffing box *B*, which is fastened to the steam gauge stand by means of the two studs *b b*; these studs are also used for tightening the brass gland *C*. The stuffing box is bored out at one end to receive the hemp packing and the gland; the other end of the stuffing box is tapped, and the wrought-iron tube or pipe *K* screwed into it. This pipe is about $\frac{3}{16}$ of an inch thick, and is the same kind of tubing as used for water grates, to which we shall refer later on. The other end of the pipe *K* is screwed into a small brass flange; the latter is riveted to the outside of the dome, and is completely covered by the dome casing. The pipe *K* is not bored out; its inner diameter is somewhat larger than the diameter of throttle rod *G*, so as to give the latter ample freedom for its motion. The purpose of the pipe *K* is to cover and protect the throttle rod, and in the meantime bring the stuffing box *B* and gland *C*—which are required in any case—within easy reach of the engineer.

In this design the jaw *H* and the jaw at the opposite end of the throttle rod are keyed to the latter, as indicated in Fig. 528; this way of fastening the jaws to the throttle rod differs a little from the manner of fastening similar jaws, which have been previously illustrated. The wrought-iron link *I* forms a connection between the throttle lever *E*, and the lug c_2 cast to the steam gauge stand *A*, and serves as a fulcrum for the former.

The manner of locking the lever *E* differs greatly from any of the previous designs. The upper side of the jaw *H* (Figs. 525, 526,) is extended sideways and formed into a circular rack; the pitch of the teeth is very fine, so as to obtain a regulation of the throttle valve as close as possible to the requirements of the engine; yet with this arrangement it will be difficult, if not impracticable, to obtain as close a regulation as with the design shown in Fig. 518 (last paper). A steel latch *L*, having three or four teeth cut in its end, engages with the rack. The lug forged to the bottom of the latch, and sliding in a slot cut through the lever, serves as a guide for the latch; the link *F* connects the latch to the handle *M*, which, in being pressed towards the throttle lever handle, disengages the latch from the rack, and leaves the lever free to move. In moving the lever to and fro, the latch *L* will move faster than the pin *d*, and it is on account of the difference between the rate of these motions, that, when the latch *L* engages with the circular rack, the lever is locked. The steam gauge is fastened to the upper part of the stand *A*; the center *f* on this stand coincides with the center of the steam gauge.

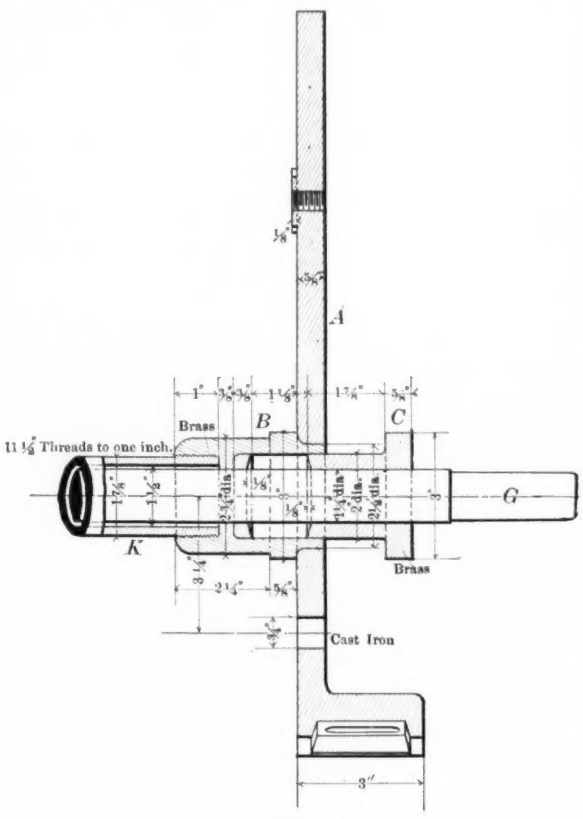


Fig. 527

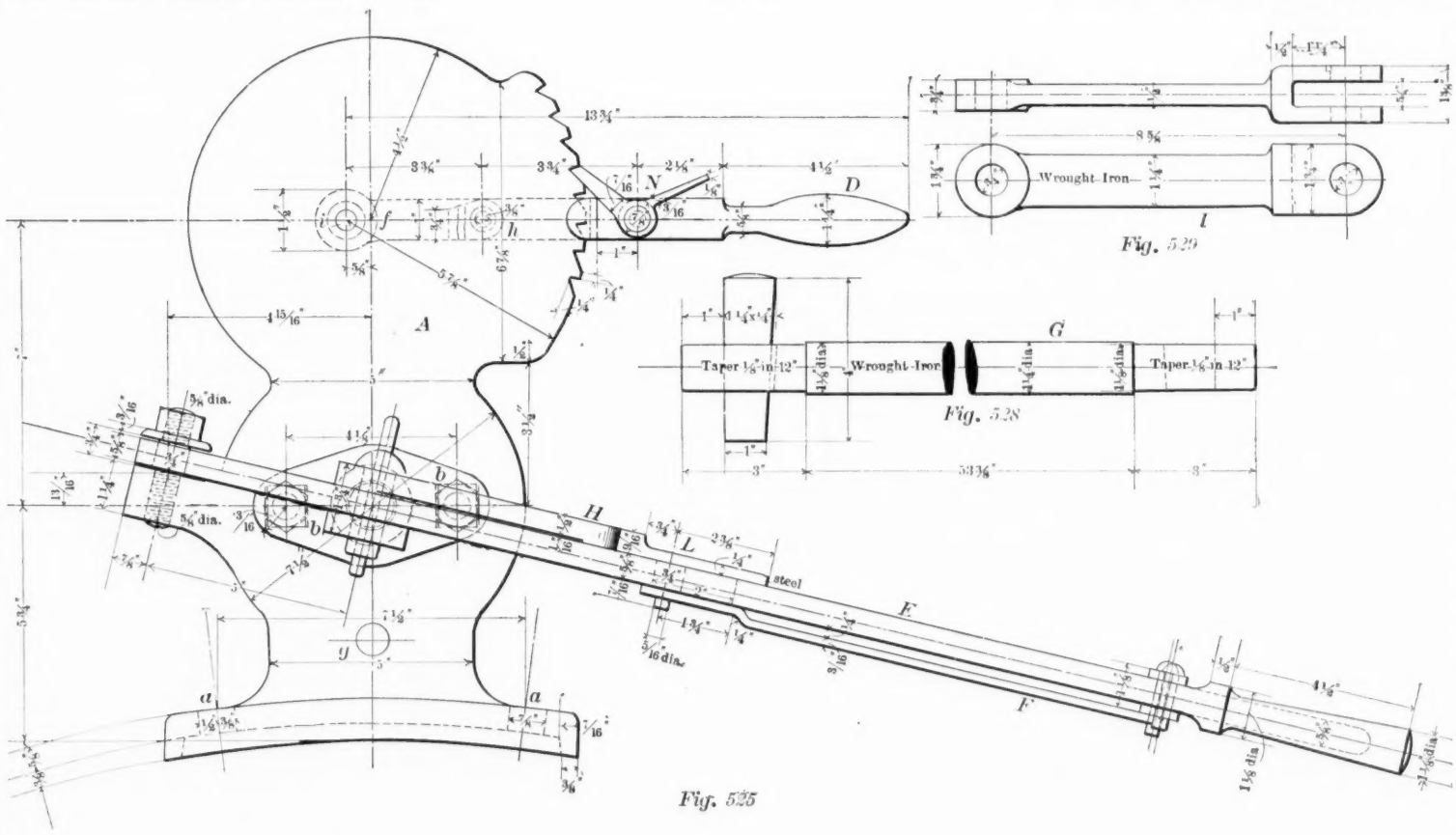


Fig. 525

Fig. 529

Fig. 528

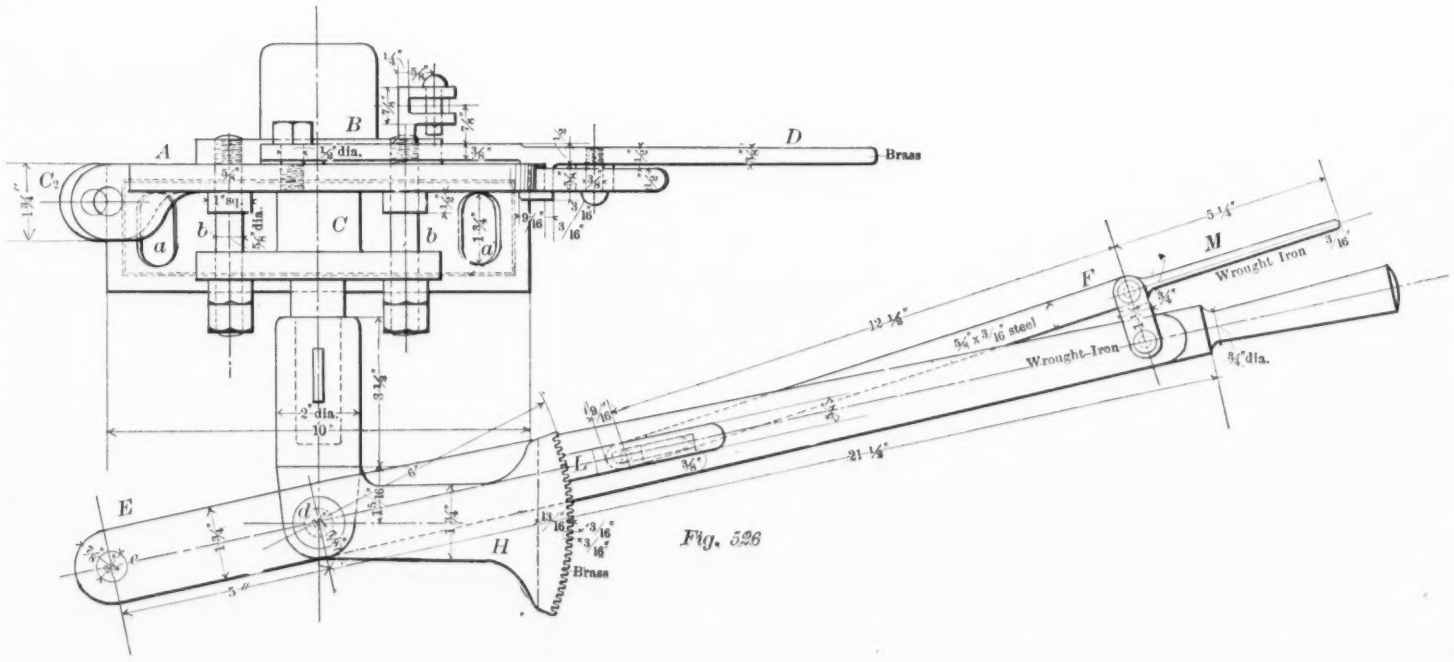


Fig. 526

The lever *D*, *D*, Figs. 525, 526, is for the purpose of opening one of the safety valves, or regulating the pressure on the same; the pin *h* connects a spring balance—not shown—to the lever *D*; this spring balance stands in a vertical position with its upper end attached to the safety valve lever; the handle *D* swings on the pivot *i*, which is cast on the back of the steam gauge stand *A*; the pawl *N* engages with the teeth cut on the edge of the steam gauge stand, and prevents the lever *D* from moving upwards. In pulling the lever downwards, the pressure on the safety valve will be increased.

The safety valves and spring balance will be described later on; all that we need to say here is that two safety valves are always used for a locomotive boiler, and it is only one of these that can be released, or the pressure upon it changed by the lever *D*; the other safety valve is or should be beyond the control of the engineer.

The latest statistics of Krupp's establishment are supplied in a book just published at Essen. In 1833 it had nine workmen; in 1848, 74. In July, 1888, it employed 20,960 men, of whom 13,626 were at Essen, and, including the families of the workmen, it supported a population of 73,769 souls, of whom 24,193 lived in the houses it provides. There are at Essen 1,195 furnaces of various constructions, 286 boilers, 92 steam hammers of from 100 to 50,000 kil., 370 steam engines with a total of 27,000 horse-power, 1,724 different machines, and 361 cranes. Of coal and coke 2,735 tons are used daily, and 11 blast furnaces of the latest construction produce nearly 600 tons of iron per day.—*Engineering.*

A Los Angeles (California) paper, in describing the recent opening of a cable railway in that city, states that the boilers, which are of the Wazelon pattern described in these columns May 28, 1889, says that the boilers are believed to be the largest known, being rated at 500 horse-power each. They are 10 feet diameter 44 ft. high, each containing 1,600 tubes 4" diameter and 36" long.

LETTERS FROM PRACTICAL MEN.

Ammonia Engines.

Editor American Machinist:

Prof. James E. Denton has given us a valuable table for comparison of steam, ammonia and allied engines, but there are some of the claims of the advocates of the ammonia engines that would bear a little further investigation, inasmuch as they would claim that it is not hit upon in that table.

They claim that with the ammonia engine there are but 540 rejected heat units or latent heat thrown away in the exhaust, while with steam there are 1,000 heat units, thus claiming a gain there of nearly 50 per cent. A moment's thought would show them that steam at 70 lbs. pressure has a total heat of 1,210°, and rejects say 1,000°; while the ammonia gas has a total heat of about 640°, and rejects 540°; in other words, it starts with a little over half the total heat of steam, and rejects about the same per cent. that steam does. They are simply dealing with one-half the heat.

The claim of avoiding cylinder condensation is questionable. Ammonia gas being a fixed gas, like air, etc., is not condensed by the simple abstraction of heat, so that a surface condenser is of no value for an ammonia engine; but a jet of water must be mixed with the exhaust before it can again be brought into a condition to again enter the boiler, and the gas leaving the boiler is saturated with vapor from the water. This is unavoidable, and is it not probable that this vapor, being at a temperature lower than that due to its pressure, is condensed on its way to or in the cylinder?

Another claim is that ammonia engines require no cylinder lubrication. It should be put that it would be impossible to use oil in ammonia engines, as it would turn their boiler into a soft-soap factory.

A further claim is that ammonia will keep a boiler clean and sound.

Inland cities are having quite a problem what to do with their sewage. Most of it goes into the streams on the banks of which the cities are located, and boiler owners who are so situated that they get large quantities of it in their water are having a great deal of trouble from the ammonia gas from the water charged with sewage. It is terribly corrosive in its effects after it has once got started on the iron, and at present there is no known remedy but a change to some other water.

W. E. CRANE.

Packing Piston Rods and Pumps.

Editor American Machinist:

There is quite often displayed a great deal of ingenuity in the packing of glands in a steam plant. Especially does this obtain in a plant which has been running for years, and is naturally beginning to show the results of years of faithful duty. With rods worn taper, perhaps fluted or scored, and out of line, the trials of packing begin. With the many elegant and costly packings on the market, it would seem as if there should be no trouble, and yet there may be even while using such; for the fact is that almost any of them are good when the conditions are good; and it is also true that not every engineer can get such packing.

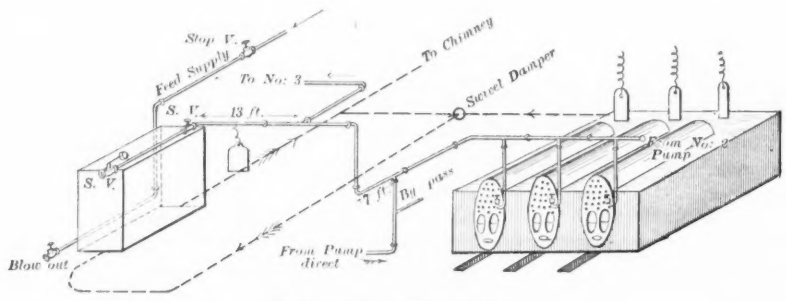
Perhaps the cold water pump used for boiler feed or tank purposes is as often in bad shape as any other machine as regards packing. It is so easy to draw up the gland so that it don't leak, until the friction is, quite often, enough to demand more throttle opening, and a badly worn, if not scored rod, soon results. Of course he will tell you that the packing is no good. The fact is that the water end is the easiest gland to be packed. One thing you need; that is, rubber; I have taken old bicycle tire when pliable, and have laid for a bit of good rubber from played-out hose, and have rejoiced in getting hold of a worn-out air-pump valve from a condenser. Trimming the rubber off in good shape, its length should be such as not to allow the ends to meet, and it should be wrapped with either hemp, candle-wicking, asbestos wick or canvas. Try for yourself which will suit your conditions. I use largely hemp, and try to get it smooth from twigs, and to give it a spiral twist before putting onto the rubber; have also used both of the others mentioned with excellent results—but hemp is the cheapest. Pack fairly home, and draw the nuts till you feel the cushioning spring of the rubber. Should your rod be in bad shape, and very hard to hold, pack alternately with some of the manufactured packing, giving preference to pliable goods. Use your own judgment in buying, as the results are on your own head. Such packings range in price from 20 cents to $1.50 per pound.

If your rod is badly fluted—and lots of them are—go at it with a file and emery cloth until it is smooth enough not to cut the packing. Fill the gland with waste while at it, so none will enter the cylinder. Finishing up, either draw-file or work the emery cloth lengthways. Should your rod be worn taper—and it seems that few are not—you will find this style of packing particularly useful and satisfactory. Not always can one get a chance to have the rod out and trued in the lathe, and in the hurry of more important work, when the shop is shut down, the rods are neglected. I have come to the conclusion that the pump manufacturer could help us out if he would make the rod smaller in diameter where it does not touch the packing, say $\frac{1}{16}$" less; try it, some of you pump men, and it will be appreciated. The wedging taper, that is so annoying as you try to run your pump slowly, could be removed more easily and more truly. In regard to lubricants for packing, there are various kinds used, from plain engine oil to some special mixture. You will get better satisfaction from a mixture of tallow, cylinder-oil and plumbago, than plain oil. This mixture, if the water is, say at 120°, will be better by using some beeswax, melting and mixing together, and applying with a brush say once a week. I use this mixture on hemp, lamp and asbestos wicking before packing, and thoroughly mix it through the fibers of the packing. To those who have never used this, or similar mixtures, I will say that you will be delighted with the results of a trial. The fact is, that I use such a mixture almost every day, and on various things, from the threads of a bolt to the face of a gasket—and always with good results. The life of a hemp gasket can be indefinitely prolonged by its use, and it will assist the wicking to prevent leaking of the meanest globe valve stuffing-box you have on the premises. Once tried always used holds true of this. I know of one engineer in charge of a 24"x48" engine who packs the piston rod on his engine with good, clean waste twisted loosely, and well saturated with tallow, plumbago and bees wax. Of course he mixes in good judgment, and gets it packed just so, and don't set it up with the big monkey wrench. As the waste is worth say 10 cents per pound, his employer doesn't pay much for packing, and his rods are smooth as new, while there is no steam blowing. There are many paying big bills for packing who could profit by trying some of these simpler home-made things.

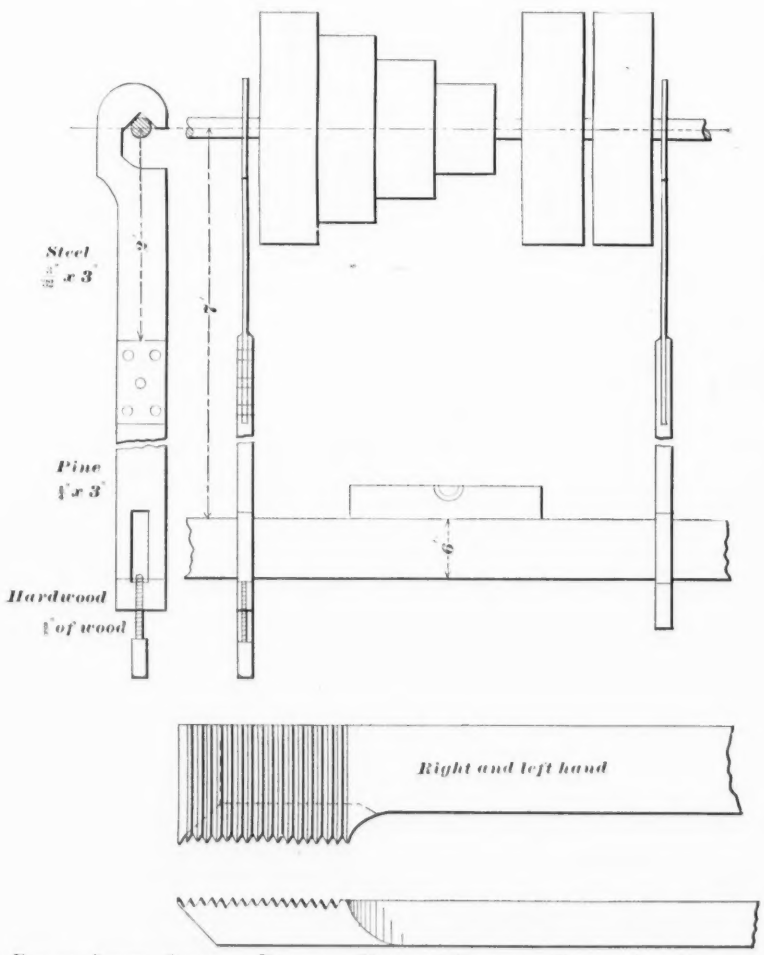
In regard to the use of rubber in the steam end one must be careful; not but that many are satisfactorily using it, but because it demands more care and skill in packing and in tightening up. No rule can be laid down to fit all conditions, and yet I should advise giving preference to soft pliable packing.

There are two ways to pack a steam gland. One way is to fill with a solid hard packing and screw it up solidly; there is no give to it, nor life or spring about it, and unless carefully watched and frequently oiled, the result will be a worn, if not a scored, rod. I say nothing of the friction of such packings, as that varies as the square root of the brutality of the engineer in charge. The other way is to fill the box with some light, soft pliable packing that adds no friction, takes little oil, scores no rods, and lasts reasonably well. Should your rod be in bad shape—and still you have not time to true it up—get some rubber and cut in such shape as to keep from touching the rod, and yet to act as a cushion for packing. A **V**-shape is a good way, allowing the sharp edge to point toward the rod. As the rubber will swell with steam, adjust the nuts carefully, and you will find that this is an elegant article to interpose between the light, soft packings. One of the finest packings in the market is made on this principle; and I know that fifteen years ago I worked the same scheme while a locomotive fireman. Used on the pump or the engine that packing is best, other things being equal, which holds the best with the least friction.

T. T. PARKER.



ISOMETRICAL DRAWINGS.



RIG TO LEVEL SHAFTS—PATTERN MAKERS' TURNING TOOL.—SEE PAGE 7.

Isometrical Drawing.

Editor American Machinist:

I can speak from experience of the great value of the art of isometrical projection to the engineer; when out taking dimensions, for example, it is sometimes most useful to be able to show the three views on one sketch, and in certain cases it is almost impossible to give adequate particulars or convey correct ideas to others without going to considerable trouble in lettering and referencing the different views requisite to give the particulars wanted. In writing the foregoing I had in my mind certain special work which I was at one time constantly called upon to perform, namely, to show the positions and attitudes of the various feed pipes, both supply and discharge, in relation to that class of feed-water heater known as Green's economizer, and the boilers supplied therefrom. The sketches customarily made were mere plan views of the pipes. Vertical lengths in such cases had to be shown by a small circle, and the words "up" or "down" written to such circles. It was not customary to show end and side elevations, but the need of them was often felt. In some cases, especially in old-established places, the intricacy of pipes would be very great. To follow the pipes on an ordinary plan and elevation drawing would be liable to cause errors, but in making an isometric sketch it was very easy to note so many lengths of pipe running in one direction—call it forward, so many to right, to left, up or down, and to sketch them in pictorially, marking down as many times nine feet as there were lengths of pipe.

The annexed sketch somewhat resembles cases I have met with, but only the latter portions are here shown, the feed to No. 3 boiler being simply indicated where it branches off. The idea is sufficiently evident, however, and the sketch shows how easy it would be to include any number of pipes. Some systems I have met with present infinitely greater detail, such as separate feed pipes from the pump on the main engine, the donkey pump and the injector, and there will be found various connections through the feed heater, and direct to the boilers and to the by-pass or relief valve. Sketches thus arranged facilitate reference to pipes, and afford a means of studying improvements. The arrangement of flues and dampers, as indicated by the dotted lines, can be rendered evident on the same sketch, as well as steam pipes.

As a rule in isometric sketching one regular rule should be employed, which is that vertical lines remain vertical. Another rule is that horizontal lines are all inclined 30° from a rectangular co-ordinate to the vertical. In the sketch this is not done. I have found it more convenient to make one set of horizontal lines parallel with the lower edge of the paper, or simply at right angles with the vertical. The other set of lines incline at about 40°. In the correct isometry the three lines which meet at the corner of a cube—no! a brick—incline at 120° from each other. In the approximate method I use an end elevation, as seen in the case of the economizer, showing right angles as right angles which are on one vertical face, but on the adjoining vertical face and in plan, all right angles become either less or more than 90°.

Though not standard practice, I have found

this system very convenient. Flues can be shown, of course, on the same sketch. Of course in rapid sketching I would only show pipes by single lines, indicating flanges by a small ellipse and valves by a cross, and the letters *Ck* or *St* or *Sv*, *Bo* to indicate check, stop or safety valves, or blow out.

An inconsistency, such as the inaccuracy of the approximate method will be termed by some good draftsmen, will not be objected to by those whose skill in drawing is limited.

Personally, my powers of sketching are of this latter class, and though practice enables me to improve on the crude effect herewith accompanying, and even to use correct isometry, I can well understand that there are many who will welcome my easier method as a means of showing pipes, etc., and who will by actual practice attain to better things in time. The leisure of many is too limited to acquire perfection by mere study, and actual practice is after all the best school of design.

W. H. BOOTH.

Rig to Level Shafts—Pattern Makers' Turning Tool.

Editor American Machinist:

I enclose you sketches of a couple of ideas that may be of use to a few of your many readers.

The first is a handy rig which we used recently to level our line to countershafts. It is first hung on a section known to be level; the straight-edge is then set true by the adjusting screw, upon which it rests. Straight-edge slides easily in mortises, and may be of any convenient length. The lower end of hooks should be weighted; they will then assume the perpendicular much quicker. The idea was suggested by Mr. D. E. Whiton. The sketch shows clearly its construction and application. The other is an improvement in pattern makers' turning tool. I found by grooving, as shown, the tool retains its cutting edge much longer, cuts more rapidly and leaves a better surface. The lateral motion given to it in using, prevents grooving the work. It is especially good on the pulley rims, it does not chip them at the joints.

GEO. S. CURRIE.

The Great Telescope.

Through the courtesy of Warner & Swazey, Cleveland, Ohio, the builders of the Lick telescope, our office is adorned by a fine picture of this, the largest and finest telescope yet constructed.

The following condensed statement of facts regarding the instrument will be found interesting:

This instrument, the largest and most powerful refracting telescope in the world, was erected in 1888, at the Lick Observatory, which is located on Mt. Hamilton, in Santa Clara county, California. It is about fifty miles southeast of San Francisco, and twenty-six miles east of San Jose. It is 4,200 feet above sea level, and in sight of the southern end of San Francisco Bay.

The column is of cast-iron, 10x17 feet at the base, and 4x8 feet at the top, and weighs 20 tons. On this rectangular column rests the head, weighing 4 tons, in which is journaled the polar axis.

Around this head is a balcony, on which the assistant astronomer is stationed. By a system of wheels he is able to adjust the instrument on any star desired, and read its position by microscopes, illuminated by electric light. Access to the balcony is gained by a spiral staircase on the south side of the column.

The polar axis is of steel, 12 inches in diameter, 10 feet long, and weighs 2,700 pounds. The declination axis is also of steel, is 10 inches in diameter, 10 feet long, and weighs 2,300 pounds.

The tube is of steel, 57 feet long. Its diameter is 4 feet at the center, tapering toward each end to 38 inches. The tube complete, with all its attachments, weighs 5 tons. This is made to follow the star by means of a driving clock weighing one ton, controlled by a double conical pendulum, which is placed near the top, and within the column, and is reached by a landing from the spiral staircase. At the side of the great tube three small telescopes of 6-inch, 4-inch and 3-inch aperture are attached, which serve as finders.

The magnifying power ranges from 180 to 3,000 diameters.

The object glass is 36 inches clear aperture, and weighs, with its cell, 532 pounds. By special accessories the telescope is adapted to spectroscopic, photographic and micrometric work.

The center of motion is 37 feet above the base, and when the telescope is pointed to the zenith, the object glass is 65 feet above the base of the column. When turning the instrument in declination, the weight that is put in motion is 7 tons, and when turning it in right ascension 14 tons are being moved. The total weight of the instrument is 40 tons.

The Engineers of the Old World Greet the Engineers of the New.

(Communicated.)

It will be remembered that a short time since the steamship "City of Richmond," of the Inman Line, was chartered by members of the Civil, Mining and Mechanical Engineering Societies of the United States to take abroad such of their members and their families as could find leisure to visit England and the French exposition. So numerous were the applications for passage, that the ship was not only filled to its full capacity, but a portion of the "City of New York" was also engaged for the purpose of conveying the overflow.

So swiftly do events move in this progressive age, that it seems as if the cheers which rang out from the crowded dock and from the vast "can't-get-away" throng who gathered there to bid them good-by, had scarce died away, when there came to us across the sea the echoes of the enthusiastic greeting which their brethren of the Old World gave them, as their outstretched hands bid them welcome to Albion's shore. The first event of which the wires bring to us any knowledge, was the gathering of "the clan" about the tables of the Institute of the Civil Engineers in London, whereon in prodigal profusion were spread the instantaneous views obtained by different engineers on the way over. Just what these views were we shall hope to learn, and perhaps to see, later on; but it is safe to believe that the victims will do their best to call in the prints and to smash the negatives. On the afternoon of June 13th, the engineers of London and vicinity tendered them a reception at the House of the Civil Engineers in St. George street, and when tney were formally welcomed by Sir John Goode in behalf of the engineers of Great Britain, Past President Thurston, of the Mechanical Engineers, the wires tell us, responded in what all who know him will readily believe were admirable terms, and which speech was supplemented most admirably by other speakers.

The generosity of the Londoners had provided, in the refreshment rooms below, a repast such as can only be found in that land of good eaters; and, in compliment to the national taste of their guests, learned no doubt through what Dickens had told them of us in his "American Notes," they undertook the compounding of a variety of fluid mixtures, the peculiar composition of which, and the success of which, will only be fully known when some of the survivors return to the "land of steady habits."

When, on the evening of the same day, they were invited to a banquet given in honor of them, within the walls of the famous "Guildhall," and around the tables of which there lingers the aroma of Lord Mayor feasts of hundreds of years agone, we can readily fancy the quiet nudge some of the western world fellows would give a neighbor, as under his breath he whispered, "Gosh, aint we going it?"

It was a handsome compliment to the American engineers that the Lord Mayor of London should tender the use of "Guildhall" for such an occasion, and it was not only a compliment, but a proud moment for them, when the son of the people's President arose as the U. S. Minister to England, to make his first speech in that country—a speech which all agree was not only most pertinent to the occasion, but which settled his place, not in the hearts of his countrymen, as that was done long ago, but in the regards of our English friends who ever have had in their hearts a warm place for his martyr father. Of the speeches made by many, we can only conjecture; but of those made by President Towne, of the American Society of Mechanical Engineers, and of Ex. President Wittemore, of the Civil Engineers, and other Americans who spoke, we may rest assured they were in their usual good taste, and well adapted to such a gathering.

To those of us who, left behind, can only quarrel with a fate that has shut us out from all these pleasures, there will come to many of us a thought which will subdue us to a gentler, sadder mood, and that thought will be, what a proud day this would have been to "our Holley," had he but lived to see it. It was the dream of his later years to be amid just such a gathering. It was his oft expressed wish that he might, with his fellow American engineers, have crossed the seas, and to have, with them, received the cordial greeting which ever awaited him there, and which he well knew would have been extended to the societies he not only was so active in founding, but which he ever had close in his affections; and it will disparage no one to believe that the magnificent welcome, that has only just begun to be tendered to the engineers of America by the engineers of the Old World, is largely due to their kind remembrance of the genial, brilliant, world-renowned mechanical engineer of America, Alexander Lyman Holley.

ONE WHO REMAINED AT HOME.

Convention Notes.

The Association was called to order at 10.30 A. M., June 18, by President Setchel, who arrived late on account of washouts. There was a very large crowd in attendance, but about as many of the lobby as there were members.

The large International was crowded, and had no rooms left as early as Sunday noon. One commendable feature was the absence of patent couplers and other exhibits at the hotels, the supply men having rented a large show-room under the hall wherein to display their wares. The committee on entertainment for the ladies' brigade was well organized, and excursions and rides were timed to go and come to the minute, each hack being assigned to four ladies, who held a ticket for its exclusive use while they were there.

The weather cleared off so that the convention people enjoyed the first real pleasant weather experienced at Niagara Falls for about a month.

After a brief address of welcome by Mr. H. J. Sheldon, the president of the village, the business of the convention was taken up, the minutes of the last convention being approved without reading. President Setchel then delivered his annual address, which was eminently practical, and was well received by the convention. He spoke of the important work being done by the numerous railroad clubs which have been formed throughout the country, and spoke of the superior value of conclusions regarding railroad practice arrived at as a result of discussions in the meetings of these clubs. Speaking of the importance of each one knowing what is being done by others, he said:

"But it is a notable fact that sometimes what seems the best is faulty, and remains so for an indefinite length of time; but this does not come from an intelligent investigation of the subject, but rather from lack of such investigation. We do not know where we stand until we compare ourselves with our neighbors. Who has not been sitting in a railway train and imagined that a train on an adjoining track was standing still while his own was moving, until, casting the eyes upon the ground, the delusion is suddenly dispelled and we find that we are standing still and our neighbor is the one that is moving. So it is oftentimes in mechanics. We think we have the best—we are moving; but by comparing ourselves with others we find to our dismay that it is the other fellow that is moving, and that we are fast falling to the rear."

As an illustration of the progress made in the methods of doing work, he reminded the members of the old way of maintaining valve seats, *i. e.*, by throwing away the cylinders and putting on new ones, and how we had progressed by easy stages from that to the balanced valve, with its precise and scientific lubricating devices. He then briefly referred to the improvements made in piston packings, and steel for boiler plates. After briefly referring to the subjects to be reported upon by the various committees, and discussed during the convention, he announced that there had been a large contribution to the printing fund, and that the financial condition of the association was exceedingly good.

Secretary Sinclair's report showed that the number of members now enrolled was 333, made up of 307 ordinary, 12 associate and 13 honorary members, 27 ordinary and one associate having been enrolled during the year. During the year two members—Mr. S. Haines and Mr. George C. Watrous—have died.

During the noon hour of the first day there was a discussion upon the cause of bursting steam chests. Mr. Stewart, who opened the discussion, giving as his opinion that the principal cause was the generation of a gas from the oil used in oiling the valves, which, becoming heated by the friction and work of compression being done in the cylinder with steam shut off, or with the engine reversed, caused the gas to explode. Messrs. Lander, Sinclair, Peck and Wilson thought that explosions of steam chests were due simply to improper design or construction, or to the strong compressive action of the piston.

In the discussion following the report of the Committee on Boiler Covering, several members thought that asbestos was quite generally adulterated, and sometimes with material calculated to produce corrosion of the surfaces with which it came in contact. Mr. J. Davis Barnett, of the Grand Trunk, puts on rings of angle iron, projecting from the boiler about one inch; over these he puts wire netting and covers it with silicate cloth about an inch thick, covering all with Russia iron. He could not give its cost, but thought it the best covering.

The committee on Subjects for Investigation and Discussion at the next annual convention reported the following:

Compound Locomotives—Their relative efficiency as compared with simple engines. Is the saving in fuel large enough to compensate for the extra cost of compounding and of maintenance of increased number of parts? Proper proportions. Are the conditions of the American system of railroading such as to render compounding advisable?

Testing laboratories—Chemical and mechanical. Are they desirable in connection with the mechanical departments of railroads? Does a marked saving in expense, by ensuring best material through chemical analysis and physical test, result?

Link—As compared with other valve motions, Wilson's, Joy's, Walschoert's, etc. Has any device been found worthy to supersede the old-style link for economical service on locomotives, all points considered, first cost, cost of maintenance, length of service, convenience, etc.? Aside from increased grate area, are there any other advantages to be gained by placing fire-boxes above the frames?

Steel *versus* iron axles—As relates to friction, wear of journals and journal bearing, liability to breakage in service.

Brick arches in locomotive fire-boxes—Best manner of supporting them, their efficiency in consuming the various gases composing black smoke, saving of fuel when used in connection with extension front, and as compared with the diamond stack, first cost, and cost of maintenance.

Locomotives, tanks, or tenders—Best method of preventing corrosion in coal space—will it pay to shield the surface exposed to coal? If so, what is best material, and how should it be applied? The best proportion of steam passages in relation to size of cylinders and steam pressure.

The following subjects were added to the list:

The best form and size of axles for heavy tenders.

What is the relative value and length of small and large flues?

Secretary Sinclair, as usual, received praise on every hand for the masterly manner in which he has handled the business pertaining to his office, all agreeing that the proceedings of the convention are very much facilitated by his conscientious attention to business.

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CONTENTS.

	PAGE.
Sixteen-Inch Engine Lathe	1
Universal Milling Machine	1
Bent Crank Shafts. By W. H. Booth.	1, 2
Master Mechanics' Association	2, 3
Self-Instruction for Young Mechanics. By Frank Richards	4
Modern Locomotive Construction. By J. G. A. Meyer	5
Letters from Practical Men: Ammonia Engines. By W. E. Crane—Packing Piston Rods and Pumps. By T. T. Parker—Isometrical Drawing. By W. H. Booth—Rig to Level Shafts—Pattern Makers' Turning Tool. By George S. Currie	6, 7
The Great Telescope	7
The Engineers of the Old World Greet the Engineers of the New	7
Convention Notes	7
Large or Small Workshops	8
Another Great Discovery	8
The Value of a Name	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Large or Small Workshops.

A study of the question of large or small workshops by Dr. H. Albrecht, published recently in the *Jahrbuch für Gesetzgebung*, is attracting some attention, and bears evidence that the author has been at considerable pains to get at the facts connected with the subject, so far, at least, as these facts present themselves in his own country. He first inquires into the actual state of the case by ascertaining what proportion of the workshops of Germany are small and what proportion large—classing as small shops all those employing five or less workmen, and all others as large. On this basis he finds that there were, in 1882, 2,908,294 small, and 97,163 large shops, and that 61 per cent. of German workmen were at that time employed in the former.

His inquiry into the question of what lines of industry seemed most favorable to the small shops, or, in other words, in what industries they seemed best able to hold their ground in competition with the large shops under present conditions, showed that of the establishments devoted to mining, smelting and the making of salt, 99 per cent. were large; in the manufacture of chemicals, 76 per cent.; of printing houses, 75 per cent.; paper mills, 73 per cent.; shops working metals (iron excepted), 63 per cent.; machine shops and shops making instruments of all kinds, 64 per cent.

Among the industries which seem to most favor the small shop, are the making and repairing of clothing, in which 90 per cent. of the shops are small; wood engraving, 78 per cent.; fine arts, 75 per cent.; workers in iron, 70 per cent.

Inquiring into the cost of power developed by small motors suitable for small shops, he concludes that the most economical of them can compete with large engines in the economical generation of power. From this, and the rapid growth of the manufacture of the various small motors, as well as what seems probable of attainment in the way of the economical generation and distribution of electric currents, he concludes that there is ground for hope that the day of the small shop may soon return.

Granting for the moment that this is desirable, and speaking more particularly with reference to the conditions in our own country, it seems to us that the conditions which determine whether most of the establishments devoted to a given industry shall be large or small, are so many, and some of them of such commanding influence comparatively, that the question of the mere cost of the power used (though it is of prime importance in many industries, considered with reference to the competition of establishments of equal size) has really very little to do with determining what the average size shall be. There are many branches of manufacture, which, from their nature, require that those who are engaged in them shall come into direct personal contact with the consumers of their goods; and the size to which such establishments may grow will always be limited by the number of people with whom direct personal relation can be established and maintained. The better class of clothing, for this reason, is now, and probably always will be, made in comparatively small establishments. The same may be said of boots and shoes. The size of jobbing machine shops and of plumbing establishments will always be limited in the same way, as also will the shops of model makers, and, to a great extent, the makers of astronomical and engineers' instruments.

On the other hand, there are many industries in which the small shop can never hope to compete with the larger ones upon anything like equal terms, even though the motive power could be produced at equal cost per unit of value of goods produced. These are industries the products of which are absorbed through the general channels of trade, and in which it is not at all necessary or desirable that the consumer shall come into direct contact with the producer.

Complete production consists not only in the shaping of materials into certain forms, but in the procurement of those materials and the placing of the finished product in the hands of the consumer.

The commercial operations involved in modern manufacturing are of no less importance than the shaping and transforming of materials, and it is in these commercial operations, which constitute a part of manufacturing, that the largest establishments often have the greatest advantage. It often costs no more to transact a matter of business involving hundreds of thousands of dollars than one involving a few hundreds only, and there is a large class of "fixed charges," consisting of superintendence, clerk hire and advertising, etc., which do not increase proportionately to the increase of business, and in which the large establishment will probably always maintain its advantage.

Of the immense advantage possessed by the large establishment in most lines of manufacturing, due mainly to division of labor and the better system made possible by it, there is little need to speak, as this is well understood.

Finally, we think it at least doubtful if any of the advantages which some seem to hope for would actually result from the return to the small shop system. So long as the opportunities for work are restricted, and there are more men looking for employment than can find it, so long will it lie within the power of some men to oppress others, whether the shops be large or small, and those who have so much to say about "the great evils which have sprung from the massing of workmen in the large factories," would do well to inquire whether the great evils of which they complain really spring from the large factories or from other causes. There are no poorer or more oppressed workmen in America than the many thousands who make clothing and cigars in the small rooms of tenement houses in this city; and in England the nail makers, whose establishments are usually limited in size to the number in a single family able to work, are perhaps the most oppressed people in the three kingdoms. We think the tendency in many industries will constantly be towards larger establishments, and that the hope of relieving workingmen from the burdens which many think result from this, lies not in opposing their growth, but in depriving them, so far as possible, of their power for monopolization.

Another Great Discovery.

The *Boston Post* of June 12 has an account of a new method of "storing steam," from which we quote some of the most startling statements, which can hardly fail to be of interest to engineers. This new scheme is said to be especially adapted to the propulsion of street cars: "Very little fire is required, as the exhausted steam is saved and condensed in the boiler."

Now we have a faint impression that the idea of condensing the exhaust of engines has been proposed before, and that on that account the Boston genius will hardly be accorded the honor of originating the idea; but it must, we think, be admitted that its condensation *in the boiler* is entirely new, and entitles its discoverer to a medal or something.

"Any danger of explosion is averted by the boiler not becoming heated by water passing through tubes, as by the ordinary method."

Now here we have in a single, simple sentence, a new cause of boiler explosions, heretofore entirely overlooked, and at the same time a remedy for them. Of course, now that our attention has been called to the matter, it is easy to see that it is the hot water passing through the tubes which overheats boilers and causes them to explode, and this new application of the principle of cold storage, so successfully applied to the carrying of dressed beef, etc., will entirely obviate the difficulty.

Then it is said that "the weight is so evenly distributed upon four wheels that it can run on an ordinary street car track." A simple statement, which points out at once, and so clearly that it can scarcely be overlooked, the reason for the utter inability of bicycle and locomotives to run on street car tracks—the one has too few wheels, the other too many; and moreover in neither of these machines is the weight evenly distributed, and how can they be expected to run on street car tracks? How simple it all is to be sure, and how strange that no one has thought of these things before this.

The Value of a Name.

A rather curious case has just been decided by the courts of England, which involved the question whether or not a man had a right to carry on business under his own name when that name happens to be identical with the name of another carrying on the same business in the same place.

Thomas Turton & Sons, of Sheffield, it seems, had for years carried on the business of steel making, and also made springs, buffers, etc. Another man, named John Turton, was at the head of a firm carrying on the same business, in the same place, under the name of John Turton & Co., to which there was no objection on the part of Thomas Turton & Sons. But when Mr. John Turton concluded to take *his* sons into the partnership, and commenced to call the concern John Turton & Sons, there was trouble, which finally reached the courts, Thomas Turton & Sons claiming that their firm's name constituted a sort of trade mark to which they had the right of exclusive use. The courts decided against this theory, holding that, inasmuch as John Turton & Sons were doing business under their real name, there was no evidence of fraud, and therefore they could not be interfered with. It certainly does seem, however, that if John Turton & Sons had considered their own business reputation already possessed or to be built up of more value than that which they might borrow from the firm of Thomas Turton & Sons, by reason of having similar names, they would have chosen a title clearly distinguishing them from their neighbors. There is always more or less annoyance resulting from the circumstance of two firms doing business in the same place under the same or nearly the same name, and it would seem that, where neither one expected to gain anything to offset this trouble, they would be equally anxious to avoid the complication, which, of course, could easily be done.

QUESTIONS AND ANSWERS

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(257) E. M. J., Worcester, Mass., writes: I have a motor that will raise 250 pounds one foot high in one minute, at an expense of one gallon of water at 75 pounds pressure. What per cent. of the power is required to raise the weight? *A.*—17.3 per cent; in other words, you lose 82.7 per cent. of the total dynamic energy of the water.

(258) J. W. B., ——, asks: What is white metal composed of, such as you see on washing, wringing and similar machines? *A.*—White metal is composed of lead and zinc, but we don't think much of it is seen upon washing or wringing machines; the metal parts of such machinery are made of iron, tinned or galvanized.

(259) Nemo, New York, asks: How can I find the grate area, also the fire grate surface of a marine boiler? *A.*—By the term "fire grate surface" we suppose you mean the heating surface in the furnace alone. To find the grate area, multiply the width in feet by length in feet of the space occupied by the fuel; the measurements must be taken in a plane of the top of the grate bars; the product will be grate area in square feet. The heating surface is the area of the surface or surfaces which are above the grate bars.

(260) E J. B., ——, asks: Will you publish a simple rule for tapering in a lathe? *A.*—If the tool were set level with the center, and no allowance were to be made for the distance the lathe centers enter the work, then the rule would be: Divide the difference between the diameters of the small and large ends by 2, and multiply this by the ratios which the total length of the shaft bears to the tapered portion. In the case which you men-

tion it would be $(2.5 - 1.25) \div 2 \times 3 = 1.875$ or $1\frac{7}{8}$ inches. The fact that the centers enter the work a certain distance, prevents accurate results being obtained by calculation, however.

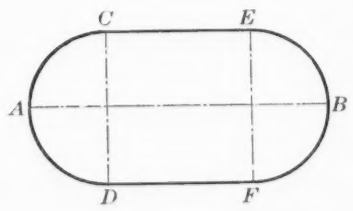
(261) C. E. Q., ———, writes: I have seen numbers of small brass screws about ⅛-inch long, and the size of common pins, that were black on the surface, and the color seemed to be the product of chemical action on the surface of the metal, rather than caused by the use of black paint or Japan. Can you tell me how to produce a like result—a black or dark color, on the surface of the metal, on small brass screws, the size of common pins? *A.*—Into 6 gals. muriatic acid put 2 lbs. yellow arsenic, and 1 lb. black oxide of iron. Have the pieces thoroughly clean and dry, and dip them until the desired shade is produced, then rinse them in clear water and dry in fine sawdust.

(262) E. J. R., Philadelphia, Pa., asks: 1. How will malleable iron stand for crank-shafts of punches as compared with cast-iron, and what percentage greater pressure will malleable iron bear? *A.*—Malleable iron is not a suitable material for such a purpose. There is little, if any advantage in using it for anything more than ½ inch thick. We have no data as to its actual strength, but it is quite variable. Regarding the other matter, we think the school you mention is a good one, and that with the experience you have had, a course of engineering in it ought to fit you for the practice of the profession, though, of course, the degree of success attained will depend chiefly upon yourself.

(263) C. F., Paterson, N. J., writes: Will you or some of your readers kindly give a description of the latest and most improved methods of case-hardening? *A.*—Make a cast-iron box or pot with a cover. Put crushed bones, crushed charcoal and burnt leather scraps together with the articles to be case-hardened in the box; put on the cover and stop up around the joint with fire-clay. Bring the whole to a red heat. How long you should keep at this heat, to give the depth of hardening you require, is something you must determine experimentally; probably from 1½ to 10 hours—the longer the time the deeper the hardening. Remove the box from the fire, and dump the contents into clear cold water.

(264) H. P., Webster, Mass., sends us a sketch of rectangular frame; to the top of the frame a bellows 7 inches diameter is attached; the bellows is made to open 3 inches. The bottom disk of the bellows is connected to an air chamber 7 inches in diameter, and 3 inches deep; the axes of the bellows and chamber lie in one vertical line, and the chamber moves up and down with the bottom disk of the bellows; the weight of all the moving parts are counterbalanced. From the bottom of the air chamber a rubber pipe ¼ of an inch inside diameter, and 3 feet long, leads into an open tank filled with water. It is asked: What weight on the top of the air chamber will be required to restore an equilibrium between the outer air and the air in the tank? *A.*- The weights on the air chamber will depend upon the construction of the bellows, of which you have said nothing; you may require a weight of 100 pounds, or you may require less than 50 pounds. 2. Can the water be made to rise in the rubber tube to a distance of three feet and flow into the air chamber? *A.*—With the arrangement shown in your sketch, the water cannot be made to rise through a distance of 3 feet; the friction will be too great.

(265) J. S., Cincinnati, Ohio, sends us questions which are not plainly stated; if we understand them correctly, they are as follows: 1. What will be the diameter of a circular smoke-stack whose cross-sectional area is equivalent to the inner cross-sectional area of forty-two tubes, 2½ inches diameter? *A.*—The given diameter of a tube is the outside diameter; the thickness of this size of tube is nearly equal to No. 13 Birmingham gauge, which is about 3-32 of an inch; hence, the inside diameter of the tube will be equal to 2 5-16 inches. The area of a circle 2 5-16 inches diameter is equal to $2.3125 \times 2.3125 \times .7854 = 4.20+$ square inches. The total area of 42 tubes will be $42 \times 4.20 = 176.40$ square inches, which is also the area of the bottom of the smoke-



stack. Now, the diameter of a circle having an area of 176.40 square inches is equal to $\sqrt{\frac{176.40}{.7854}} =$ 14.98 inches diameter. 2. The form of the smoke-stack base is given in the accompanying figure, *C E* and *D F* representing straight and parallel surfaces; *A C D* and *E B F* represent cylindrical surfaces tangent to the straight surface; the width *C D* is to be 10 inches; the area of the base is to be equivalent to the inner cross-sectional area of forty-two tubes, 2½ inches diameter; what must be the length from *A* to *B*? *A.*—The aggregate cross-sectional area of the tubes we have already found to be 176.40 square inches, and which, according to the conditions, must be the area of the figure. The two ends of this figure make up a circle 10 inches diameter; the area of this circle is 78.54 square inches. Subtracting this area from the required area, namely, 176.40 square inches, we have $176.40 - 78.54 = 97.86$ square inches, which is the area of the rectangle *C D E F*. This rectangle is 10 inches wide; hence, its length *C E* or *D F* will be $\frac{97.86}{10} = 9.786$ inches. Adding the diameter of the circle which forms the ends to the length of the rectangle, we have $9.786 + 10 = 19.786$ inches from *A* to *B*.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

20″ Upright Drills. J. E. Snyder, Worcester, Mass.
23″ Upright Drills. J. E. Snyder, Worcester, Mass.
25″ Upright Drills. J. E. Snyder, Worcester, Mass.
28″ Upright Drills. J. E. Snyder, Worcester, Mass.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Small, Speedy Drills, Am. Tool W'ks, Cleveland, O.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Hand, Nut, Taper and Pulley Taps. S. W. Card & Co., Mansfield, Mass.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illustrated. Frasse & Co., 92 Park Row, New York.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

The hook on steam engines is being supplanted by the Dill disconnecting device, made by the T. C. Dill Machine Company, 726 Girard ave., Phila., Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See June 20, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The best Emery Wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

Rubber Belting, all sizes, 77½ per cent. from regular list. All kinds of Rubber Goods at low prices. John W. Buckley, 156 South street, New York.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N.Y.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated. 12mo., cloth, $2.00. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

Patent or shop rights for sale, for perforating iron or steel plates for steam boilers, bridge work, iron or steel ship work, marine boiler heads, equal to drilled work and fifteen times quicker. Samples can be seen and circulars obtained from R. E. Dietz, 60 Laight st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including May 23, 1889 issue, 77 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 92 articles have thus far appeared up to and including the May 30, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES.

J. M. Petty & Bro., at Des Arc, Ark., are enlarging their saw mill.

S. R. Houk will build a flour mill at Lebanon, Tenn., to cost $10,000.

At Canton, Ohio, the Canton Glass Co. will build two new lears this summer.

At Auburn, Me., a new woolen mill is to be erected on Barker Mill Power site.

A. F. Fox, of West Point, Miss., is interested in a projected cotton mill at that place.

The erection of a 40-barrel flour mill at Cordova, Md., is contemplated by Warner & Cubbage.

J. W. Scott & Co. will build at Greensburg, N. C., a knitting factory, 42x80 feet, two stories high.

Furnace No. 5 of the Cambria Iron Company at Johnstown was put in blast last Wednesday, the 12th.

Woodbury, N. J., has decided to exempt from taxation manufacturers who have $25,000 invested.

W. P. Davis, North Bloomfield, N. Y., reports that his works are running over-time to keep up with orders.

A company has been organized, with $60,000 capital, to start a large shoe factory at Keyser, W. Va.

At Hopkinsville, Ky., the Lynn Milling Co. will put in roller machinery, and make other improvements.

The Brosius Sewing Motor Machine Co., of Atlanta, Ga., are purchasing machinery for their factory.

At Elberton, Ga., a stock company has been organized to build a cotton mill. W. H. Mattox is president.

The flour mill of Carroll & Barclay, recently burned at Adairville, Ky., will be rebuilt by a stock company.

At Schenectady, N. Y., J. G. Larrabee has recently started a steam knitting mill, which he expects to enlarge in the fall.

The addition of a machine shop is contemplated by the Ross-Mehan Brake-Shoe and Foundry Co. of Chattanooga, Tenn.

An addition 40x60 feet, two stories high, is being built to the wood-working factory of the Rock Hill (S. C.) Construction Co.

The Marland Mills, at Andover, Mass., are being enlarged by the building of an addition 75x160 feet, to be used for engines, etc.

At Mossup, Conn., Aldrich & Milner are erecting a woolen mill 180 feet long, which will constitute an addition to their present plant.

It is reported that Alexander K. Karig & Co., of Columbus, Ohio, contemplate moving their foundry and machine works to Attalla, Ala.

After a successful run of four years, the No 11 furnace of the Thomas Iron Company, at Sancon, Pa., has blown out, to make repairs.

J. W. Gaulbert, T. W. Moran and others have organized a company at Louisville, Ky., for the manufacture of machinery, steam supplies, etc.

A company called the Mechanical Manufacturing Co. has been organized at Chicago, Ill., to make agricultural and mechanical implements.

The citizens of Warwick, Mass., have raised $8,000 towards the erection of a shirt factory proposed to be established by E. A. Buffington, of Leominster.

S. S. Williams, of Meridian, Miss., will organize a stock company, with $50,000 capital, to operate his foundry and machine shop, which he is now enlarging.

The Richmond Locomotive and Machine Works have issued bonds for $750,000, to enlarge their works, as we previously reported they contemplated doing.

Work at the Pullman shops, at Pullman, Ill., is at present quite slack, about 1,200 men having been laid off. This is believed to be only temporary, however.

At Americus, Ga., the Americus Variety Works will build an addition to their factory, and will put in additional machinery for the manufacture of doors, sash, etc.

New water-works, or extensions of old systems are talked of at Huntsville, Ala.; Cedartown, Ga.; Columbus, Ga.; Madison, Ga.; London, Tenn.; Brenham, Texas.

The Cincinnati Corrugating Co. having moved to Piqua, Ohio., Lodge, Davis & Co. have purchased their Cincinnati plant, and will equip it as an addition to their works.

The D. Van Nostrand Company, New York, have issued a catalogue especially devoted to books on the subject of electricity, electric lighting, the telephone, electro-motors, etc.

The Babcock Printing Press Mfg. Co., New London, Conn., have issued a new illustrated pamphlet, describing their "Regular" and other printing presses for cut and color work.

At Arkalow, Kan., a mill is being erected, to cost $100,000, which for three months of the year will make sugar, after which it will work up the cane into paper, and the rest of time turn out salt.

A cotton factory is contemplated at New Birmingham, Texas. The New Birmingham Coal & Iron Co. are interested.

The Sterling (Conn.) Dyeing and Finishing Co., are about to erect a new mill 50x114 feet, and also a new machine shop and carpenter shop 38x64, two stories high, which will be equipped with the best modern machinery.

The Keystone Bridge Company, of Pittsburgh, have orders on hand at present for 10,000 tons of work—enough to keep the plant busy until fall. It is expected the works will turn out more work this year than ever before.

The Reliance Gauge Co., Cleveland, Ohio, report business very good, especially in the line of safety water columns, they having recently filled their fourth order for these from the Meriden Britannia Company, of Meriden, Conn.

The American Tool Works, of Cleveland, Ohio, intend to enlarge their plant, and will probably put in a compound condensing engine of 150 to 200 horse-power. Part of this power will probably be distributed to others by electricity.

The National Pipe Bending Co., New Haven, Conn., report business very good, especially in their National Feed Water Heater, of which they sold 45 during the month of April, and 49 in May, shipping some of these as far as California.

Geo. D. Walcott & Sons, of Jackson, Mich., are preparing to double the present capacity of their works. They have recently built for the Lansing Engine Works a shaper, having a stroke of four feet, a traverse of 40 inches, and weighing 3½ tons.

Mr. W. P. Norton, who for some time past has been chief draftsman for the Hendy Machine Co., has established a shop at Bristol, Conn., where he will build machine tools, making a specialty of drill presses for light work and the "Norton Semi-Automatic Lathe," which was illustrated in our columns March 12, 1887.

Nicholson & Waterman, Providence, R. I., have issued a small pamphlet which they call a Treatise on Stay Bolts. Though devoted to presentation of the advantage of bolts made by their machinery more particularly, it contains some things which are of general interest to all who have anything to do with stay-bolts.

The Hewes & Phillips Iron Works, Newark, N. J. have issued a new catalogue, which, besides being well illustrated by cuts giving general perspective and detail views of the Corliss engines, boilers, etc., as built by them, is well printed, and has a cover which is likely to attract attention, being embossed with a figure of a Corliss engine and a boiler, and so colored as to resemble a casting more than paper. It gives the catalogue a very unique appearance.

On account of the flood at Johnstown, the Pennsylvania Railroad Co. found it necessary to have 1,000 tons of steel rails to replace some tracks which had been washed away. The order was given to the Edgar Thomson Steel Works, and had to be commenced on raw material, rolls had to be changed, and yet the larger part of the order was rolled and shipped within 24 hours, and in 36 hours the entire order had reached its destination, 70 miles distant.

The first big plate glass was polished and turned out at the Howard Plate Glass Works, at McKeesport, Pa., June 8. The work was a success, and very satisfactory. Four slates, or thirty-two of the large plates, were polished. They range in size from 109x120 to 132x180 inches. The company has 125 men at work, and will now make glass right along, and as soon as the work of setting up twelve polishers is completed, 300 men will be employed, and the plant will be operated on double turn constantly.—*Commercial Bulletin.*

The new polishing machines of the Howard Plate Glass Works, at Duquesne, Pa., were put into operation last week, and have thus far given entire satisfaction. A perfect and uniform polish has been obtained in six hours, while the machines of old construction usually require from eight to ten hours to accomplish the same results. The Standard Plate Glass Company, Butler, Pa., have constructed improved polishing tables, by which it is claimed the sides and ends of each sheet are more uniformly polished than was possible with former tables.—*American Manufacturer.*

The loss sustained by the Cambria Iron Co. by the recent flood in the Conemaugh valley is variously estimated at from $3,000,000 to $5,000,000, most of which is on the Gautier Steel Works, which were completely destroyed. The damage to the remainder of the plant is placed at $500,000. The machinery was only slightly damaged, and the blast furnaces were unharmed. Thousands of men have been at work ever since the disaster clearing away the debris, and by July 1 it is expected to have the works in operation again. It is thought that about 2,000 of the company's workmen were lost in the flood.

Mr. A. Wilh Dahlgren, M. E., of Arboga, Sweden, in a very interesting and complimentary letter, says that "at present (June 3rd) business is very brisk in Sweden; about fifty large pulp mills are built or building, and many other works are constructed or extended. Here at 'Arboga Mekaniska Werkstad' we manufacture a great deal of large turbine wheels, from 200 horse-power and upwards—and of course, plenty of small ones. We have orders filed for several months ahead, and export our goods to South America, Russia and East Indies. We have just completed a large new foundry, to be able to meet the increased demand. For every day I think, Sweden now has made a step forward to become an important manufacturing country."

Machinists' Supplies and Iron.

NEW YORK, June 22, 1889.

Iron—American Pig.—The general tendency seems to be toward firmer, if not slightly higher prices, an advance of 25 to 50c. per ton being in some cases demanded for late deliveries. We quote Standard Northern brands, No. 1 X Foundry, $16.50 to $17.50; No. 2, $15.50 to $16. Southern brands, No. 1, $16 to $16.50; No. 2, $15 to $15.25; Grey Forge, $14.50 to $15.25.

Scotch Pig.—We quote Coltness, $21.50 to $21.75; Gartsherrie, $20; Summerlee, $21 to $21.50; Eglinton, $19 to $19.25; Dalmellington, $19.75 to $20; Clyde, $20.50, and Langloan, $20.50.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Foundry foreman of experience is open for engagement July 1. Address Foreman, AM. MACHINIST.

A thoroughly comp. and exp. mech. with progressive ideas, wants position. Confidential, AM. MACH.

Wanted—A competent, practical and pushing foreman for general machine shop. Address, giving experience and reference, D. H. C., AM. MACHINIST.

Agency or opportunity as salesman wanted by gentleman with tech. education and long exp. in the manufacture of mach'y. Agent, AM. MACHINIST.

Foundry foreman wanted—An active, energetic man of experience in a large machine foundry. Address M. L. W. & Co., AMERICAN MACHINIST.

Wanted—A pushing, practical and exp'd foreman for foundry; light and heavy work. Address, with age, ref. and exp., Energy, AM. MACHINIST.

Thoroughly practical mechanical draftsman and designer of 8 years' exp. in mach. business open for engagement; has been in charge of draftsmen and toolmkrs.; good testimonials. "Active," AM. MACH.

Wanted—Foreman—an energetic and wide-awake man, to take charge of an iron foundry; one who understands a foundry in all its details. Address Foundry Foreman, AMERICAN MACHINIST.

An experienced mechanic, who can improve upon methods and machines, desires a position as superintendent or experimenter in an established business or new enterprise. Successful, AM. MACHINIST.

Wanted—A first-class machinist for fine planer and lathe work; good pay and a steady job for a man faithful to the interests of his employer, and capable of doing satisfactory work. Address No. 841, AMERICAN MACHINIST.

Wanted—By a foundry and machine works with rapidly growing trade, a thorough moulder and machinist with from $3,000 to $5,000, to take an interest in the business, and act as foreman; must be a thorough mechanic. Address R. J., AM. MACHINIST.

Wanted—Position by a man with over 20 years' experience in the mach'y and supply business, both on the road traveling and in the office; would like to represent some mfg., and would travel or stay in office or store; large acquaintance; best references. Lawrence, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hand Bolt Cutters. S. M. York, Clevld., O.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, O.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

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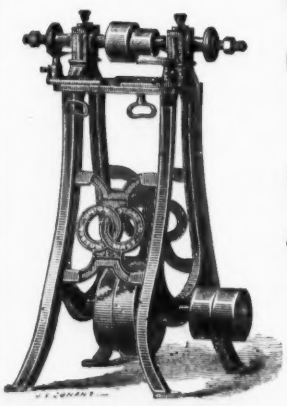
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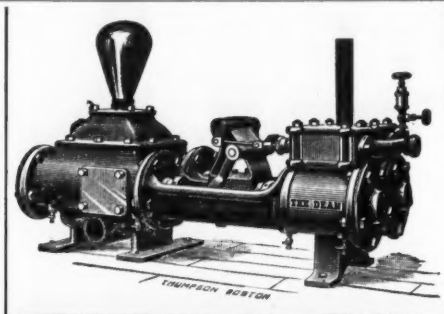
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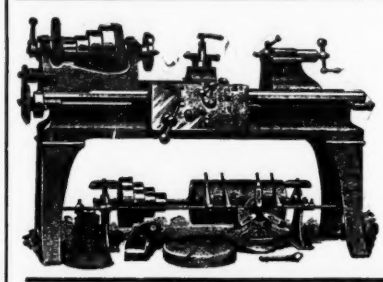
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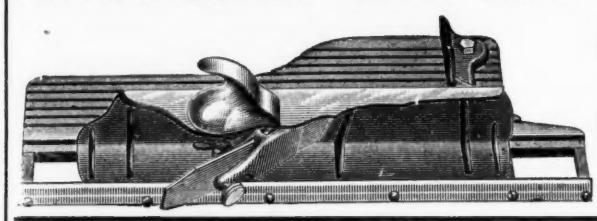
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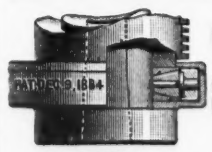

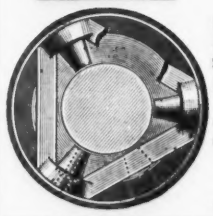
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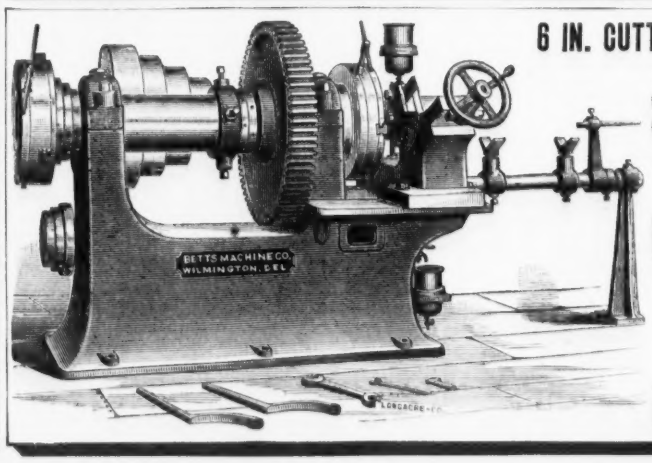

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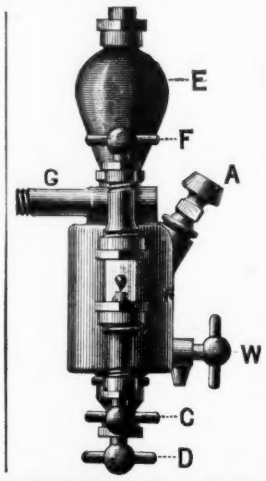

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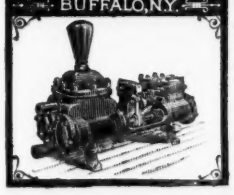

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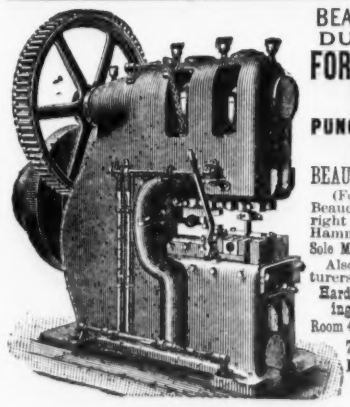

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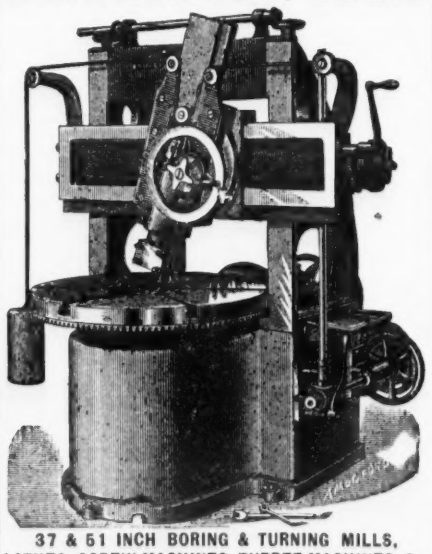

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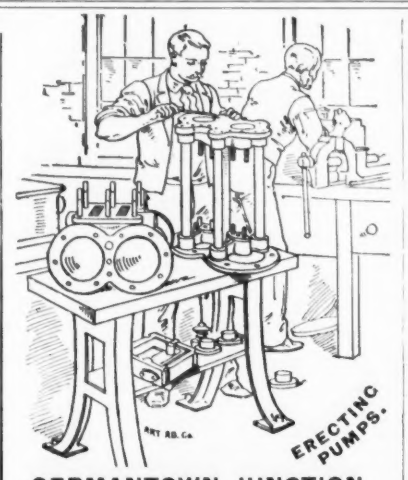

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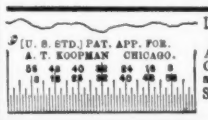

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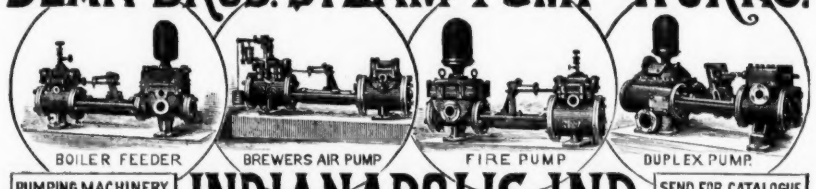

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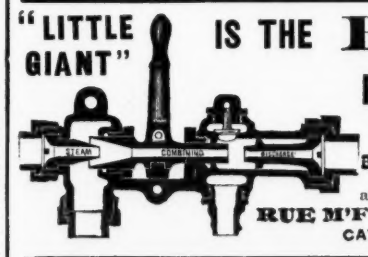

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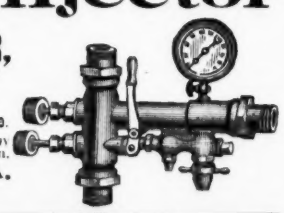

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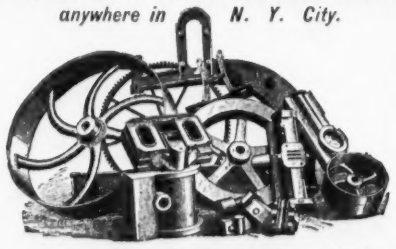

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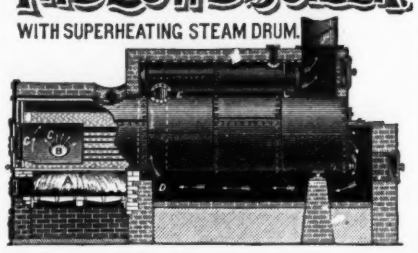

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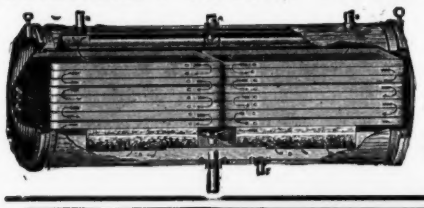

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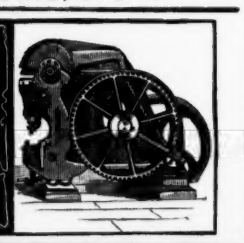

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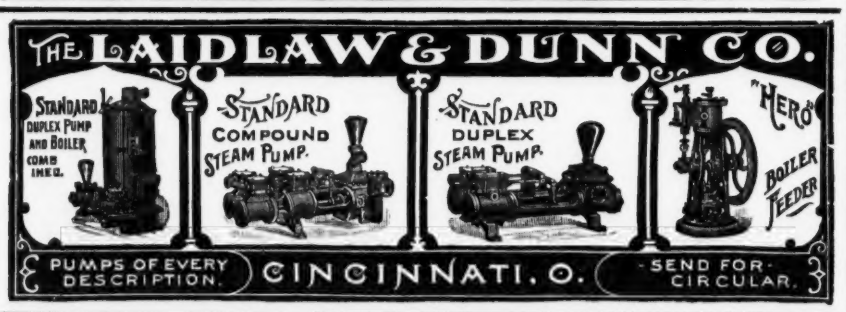

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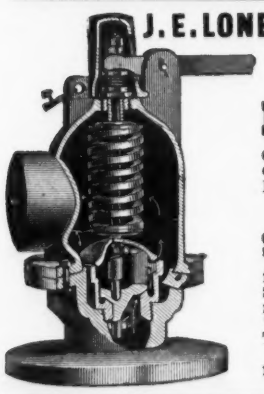

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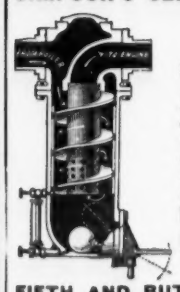

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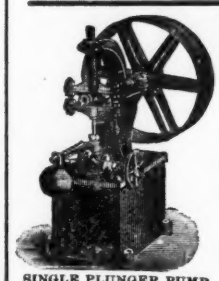

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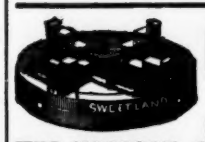

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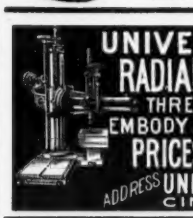

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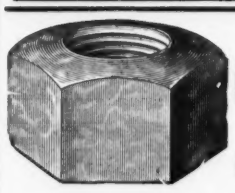

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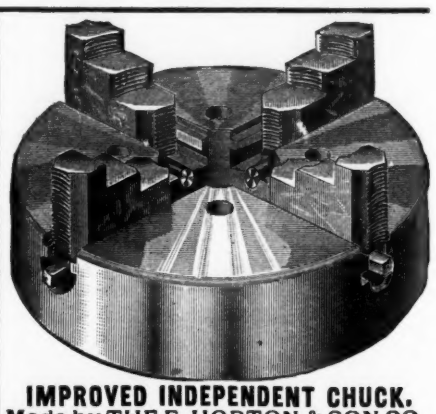

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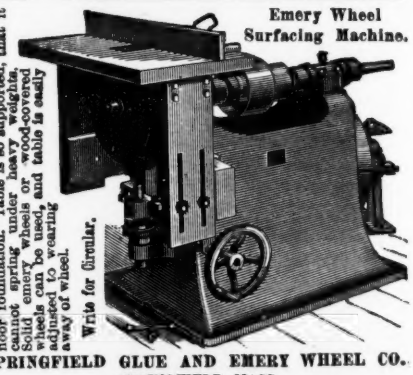

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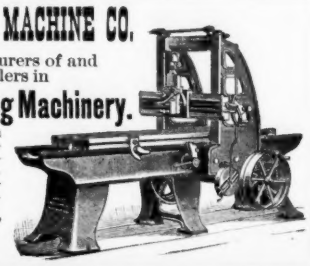

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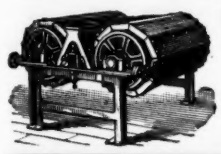

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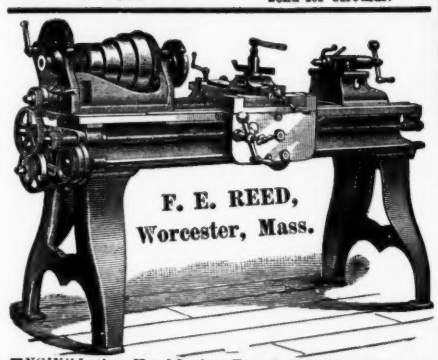

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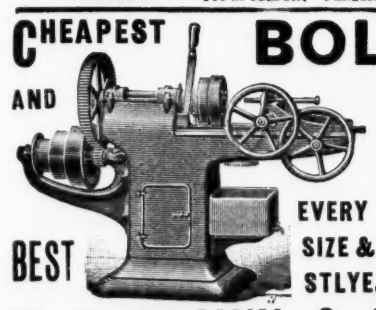

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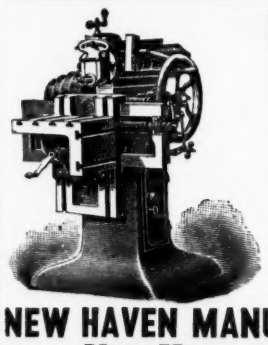

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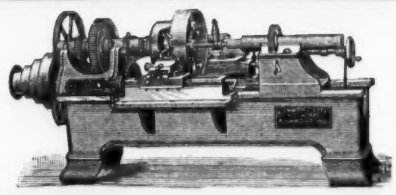

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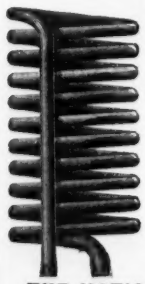

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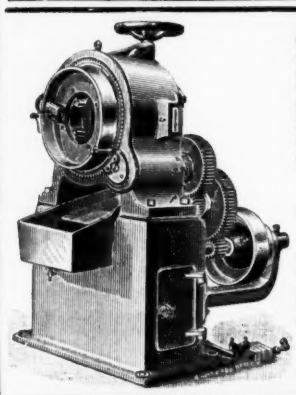

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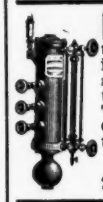

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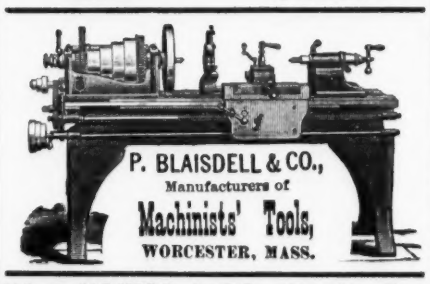

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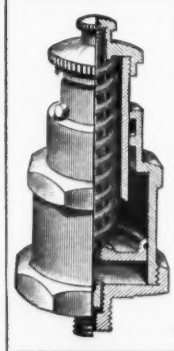

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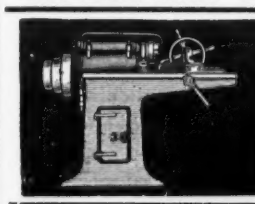

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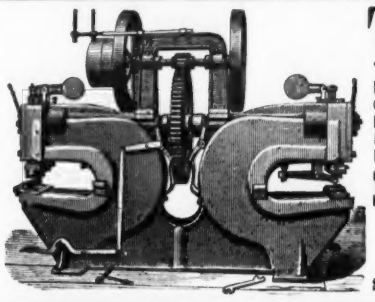

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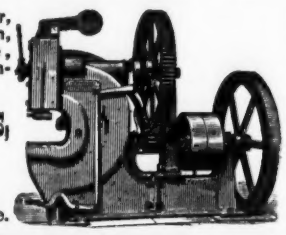

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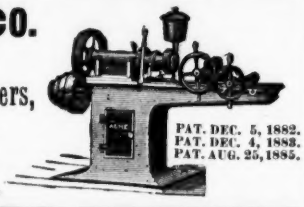

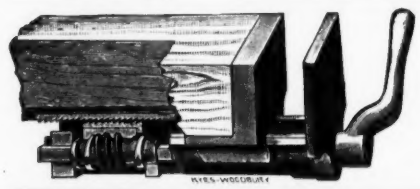

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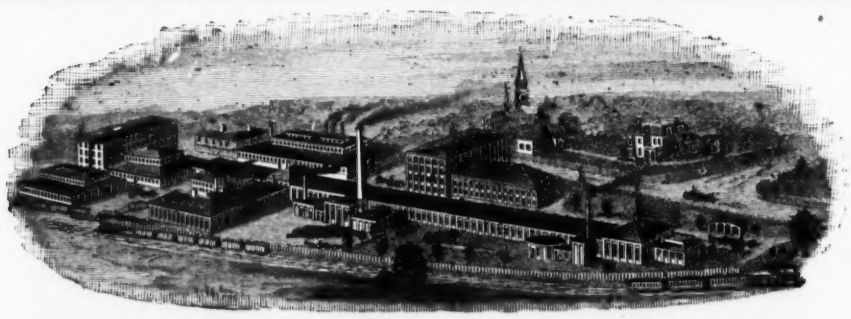

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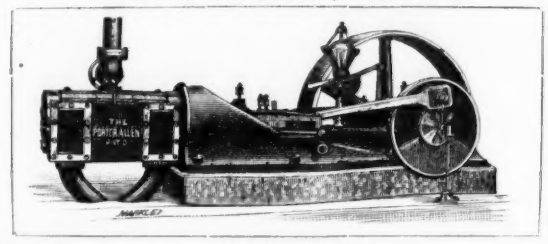

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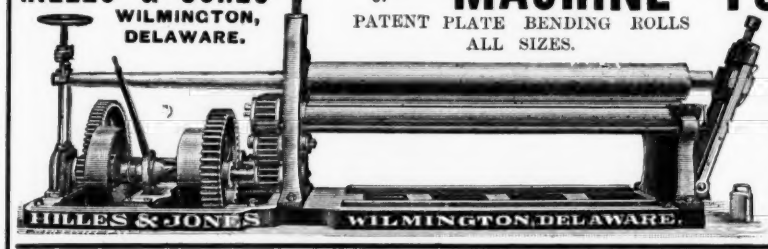

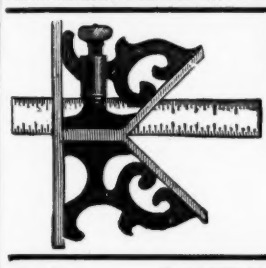

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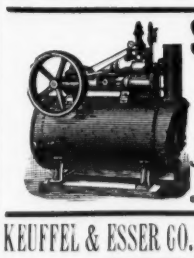

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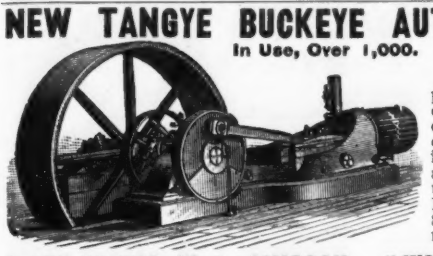
In Use, Over 1,000. 25 to 1,000 H. P.



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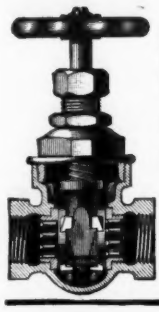

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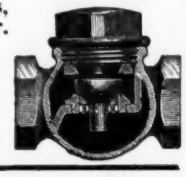

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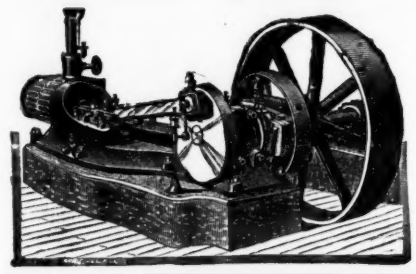

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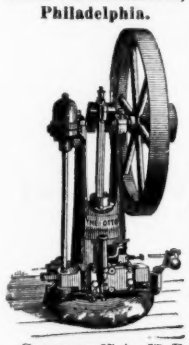

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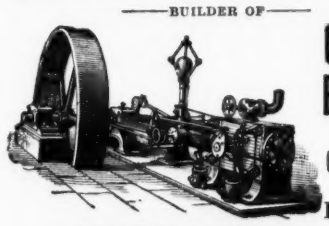

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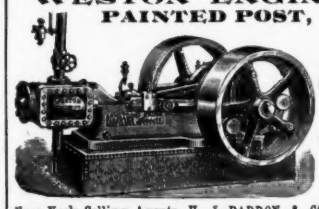

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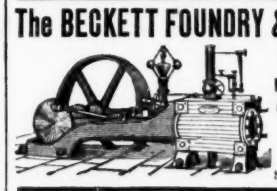

The "MUNZER" Corliss Engine.

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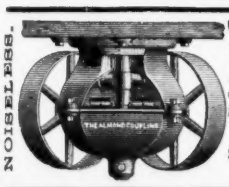

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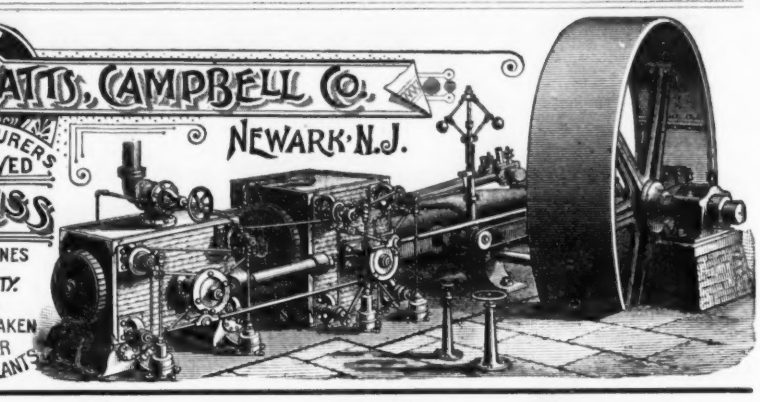

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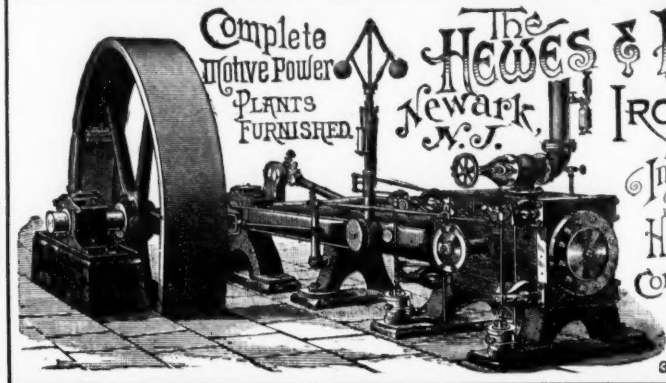

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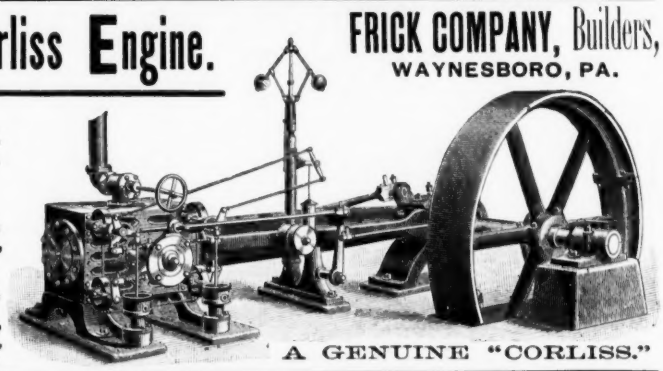

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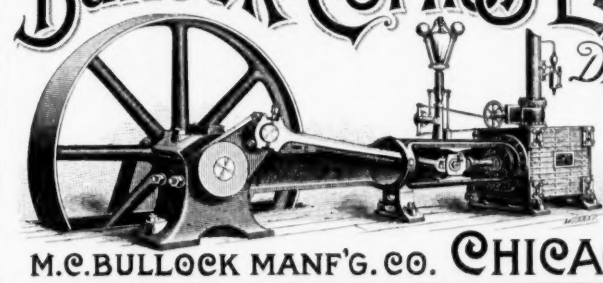

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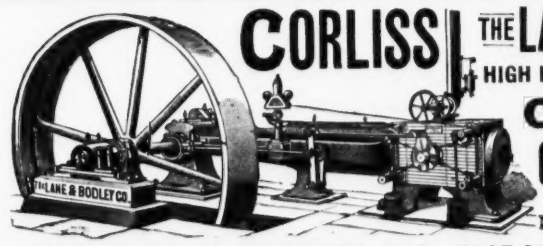

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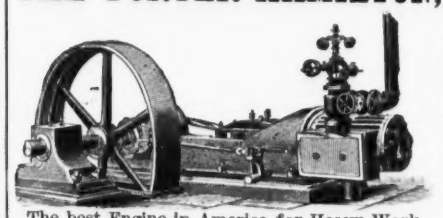

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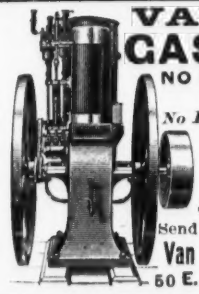

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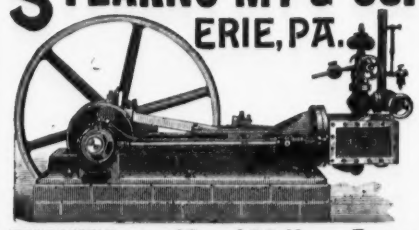

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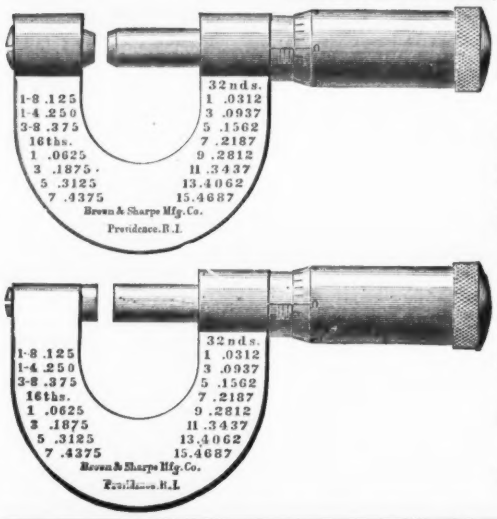

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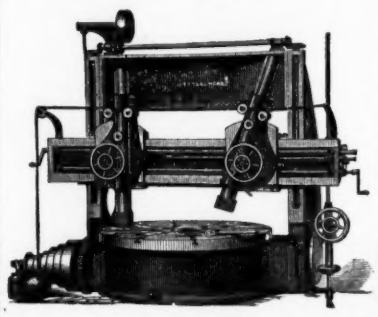

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The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

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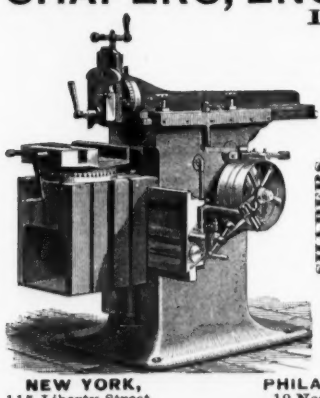

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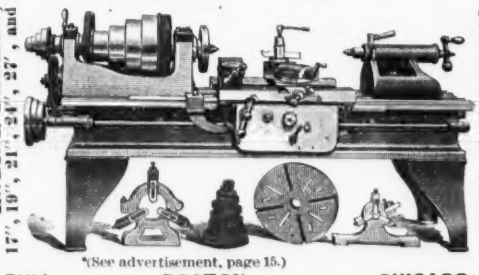

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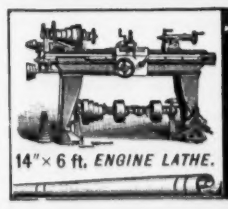

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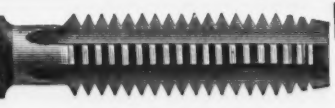

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